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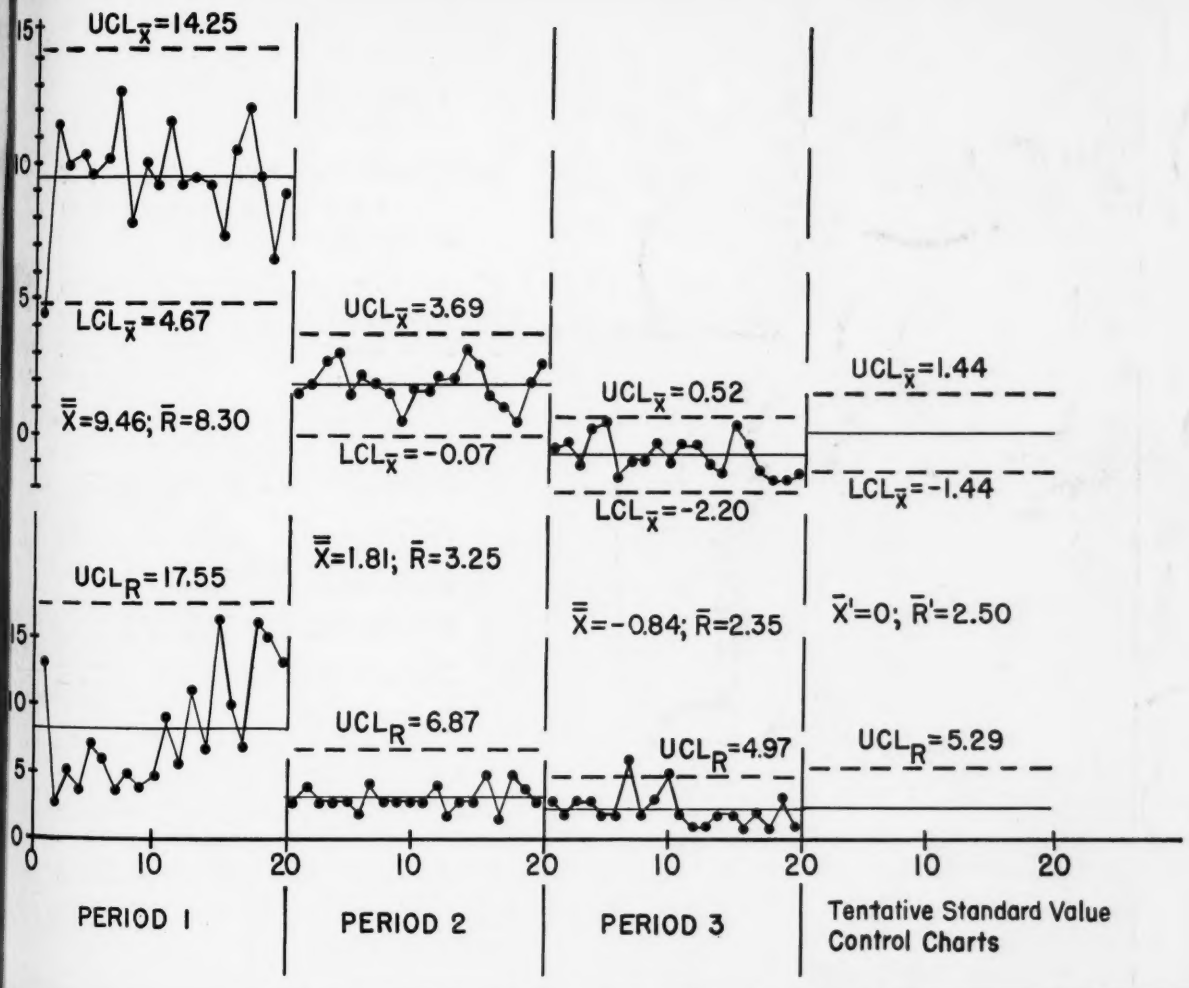

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How To Use Control Charts For Process Control

By Mason E. Wescott, page 252

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RUBBER WORLD

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NEWS of the RUBBER WORLD

U. S. Rubber Co., Firestone Tire & Rubber Co., and B. F. Goodrich Co. plants were closed by strikes in April. Goodyear Tire & Rubber Co. signed a new contract with the URPCLWA, AFL-CIO union, on April 16. Wages were not an issue. About 55,000 workers were still idle in late April and were losing more than $1 million daily in wages. If continued beyond May 1, these strikes might seriously affect the 1959 performance of the companies involved and the industry as a whole.

Polymer Corp., Ltd., the Canadian Government's synthetic rubber plant, has been closed by a strike since mid-March, with no immediate settlement in sight in late April. Exports of U. S. synthetic rubber showed an increase in March and will undoubtedly continue to do so in April.

Goodrich-Gulf Chemicals, Inc., announced large-volume production of dispersant-free SBR black masterbatches. Availability of these new black masterbatches, the usage of which has been increasing steadily in recent months, has been announced also by six other SBR producers.

A new highly fluorinated synthetic elastomer, Fluorel, Minnesota Mining & Mfg. Co.; a new liquid urethane elastomer, Adiprene LD-213, Du Pont; three new nitrile silicone rubbers, General Electric; and the semi-commercial production of Cis-4 polybutadiene, Phillips Chemical; were all announced also during April.

Total new rubber consumption at 146,815 long tons and synthetic rubber production at 111,256 tons established records in March. Both new records were due to a considerable extent, however, to the strikes and threats of strikes evident during that month.

Details of research trends and commercially available Russian synthetic rubbers have become available from the March, 1959, issue of the German publication, "Gummi-Asbest." Tremendous increases in output are planned by 1965, in Russia.

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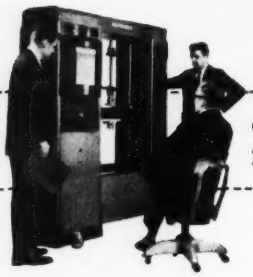

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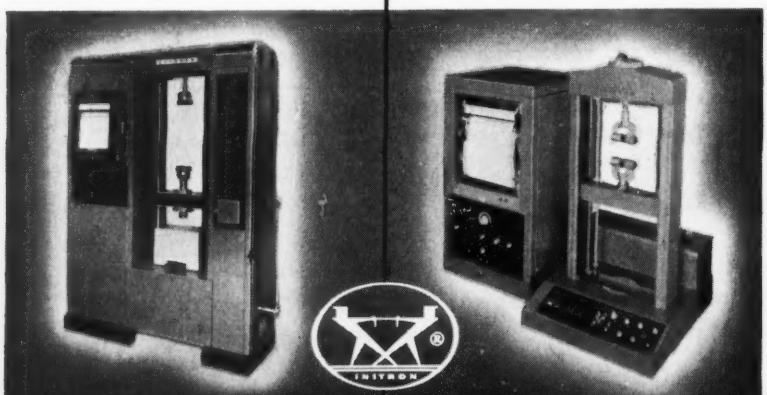

Letters to the Editor

Following the publication of the article, "Trends in Rubber Research," by A. V. Tobolsky, in our March issue, we asked several research directors and development managers for their comments in an effort to determine how Dr. Tobolsky's "effort to apply the basic principles of polymer science to the requirements for synthetic rubbers" was related to industry thinking in this important field. The replies are as follows.

April 21, 1959

DEAR SIR:

In the article, "Trends in Rubber Research," by A. V. Tobolsky, in the March issue of RUBBER WORLD, the author has made some very interesting comments on the synthetic rubbers of the present and the kind of developments that he expects may occur in the future. He has naturally stressed those things which are closest to his work and to his personal interest.

Although those working in the field would not be misled, it might have been better to head his classification of rubbers, "Categories for present Synthetic Rubbers," rather than "Requirements for Synthetic Rubbers." Certainly our needs are for rubbers with a wider range of properties than is exhibited by those we now have. For example, real general-purpose rubber should have at least the resilience of natural rubber and the abrasion resistance and good aging properties of SBR. Also, we really don't want premium rubbers because cost limits their uses so severely, but we do find certain ways of using them. Likewise it is difficult to be satisfied with rubbers which have either outstanding hot or cold properties, but not both. Jet planes and missiles, for example, may be obliged to function in both extremes of temperature.

Dr. Tobolsky's stressing of the relationship between fundamental polymer properties and physical characteristics such as the relationship of T_g to tensile strength is an important reminder that such correlations should be heeded. Borders and Juve pointed out such a correlation in 1946 in a paper published in *Industrial and Engineering Chemistry*, but more extensive use and better theoretical justification are important to progress.

The author advances some theories with regard to cleavage during network relaxation, and rubber-like properties of the tetrafluoroethylene copolymers which may well evoke critical discussion of a position which he is quite capable of defending.

The title of the paper is perhaps too comprehensive because it says very little about important areas of rubber research such as new cross-linking systems leading to improved properties and stereospecific catalysts which have given us a new control of structure.

These criticisms, however, are all

(Continued on page 174)

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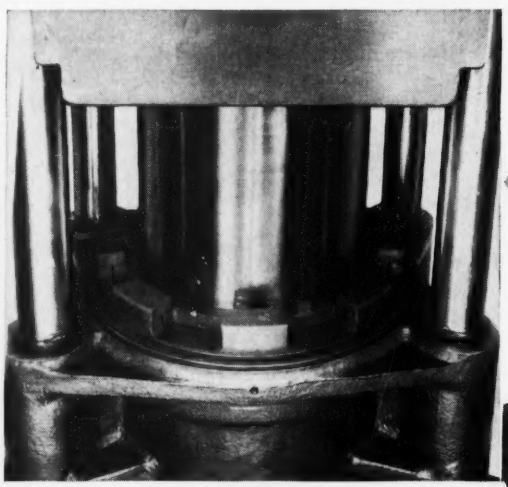

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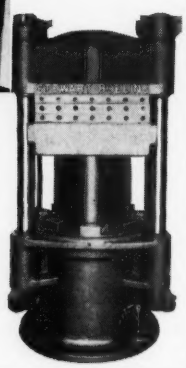

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Letters to the Editor

(Continued from page 172)

made in a spirit that should not detract from the stimulation offered by a paper of this kind.

R. P. DINSMORE
Vice President,
Goodyear Tire & Rubber Co.,
Akron, O.

April 13, 1959

DEAR SIR:

I believe Professor Tobolsky has presented a very creditable discussion of the rubber research problem. Many of us know Professor Tobolsky's work. He was very active in the synthetic rubber program during the war when he began his work on stress relaxation techniques.

I believe the most important oversight of Professor Tobolsky is that he does not recognize resin cured butyl rubber as being a high-temperature rubber and as an outstanding example of non-sulfur cross-linking. In fact he does not seem to be aware that Harry Fisher's work in the 30's led to the important commercial application of quinone dioxime vulcanization of butyl rubber during the war and postwar years.

Professor Tobolsky points out that "There is need of rubbers, however, which will be serviceable for long periods of time at temperatures from 100-150° C., and which will not be so expensive as silicones and fluorocarbons." I think Professor Tobolsky does not realize how good most of our rubbers are. The temperature range he is talking about is 212-302° F. Products made from natural rubber, SBR, nitrile rubbers, and many others regularly last for long periods of time in this temperature range. Resin cured butyl rubber will last for a considerable period of time at temperatures above this range. Witness the performance of resin cured butyl rubber curing bags which are used for hundreds of tire cures in our plants, at temperatures above 350° F.

I note that Professor Tobolsky laid considerable stress on the formation of polymer-filler bonds. This is, of course, something that we believe in rather strongly.

Despite the remarks made above, I still believe Professor Tobolsky's article is very informative and a good addition to the literature.

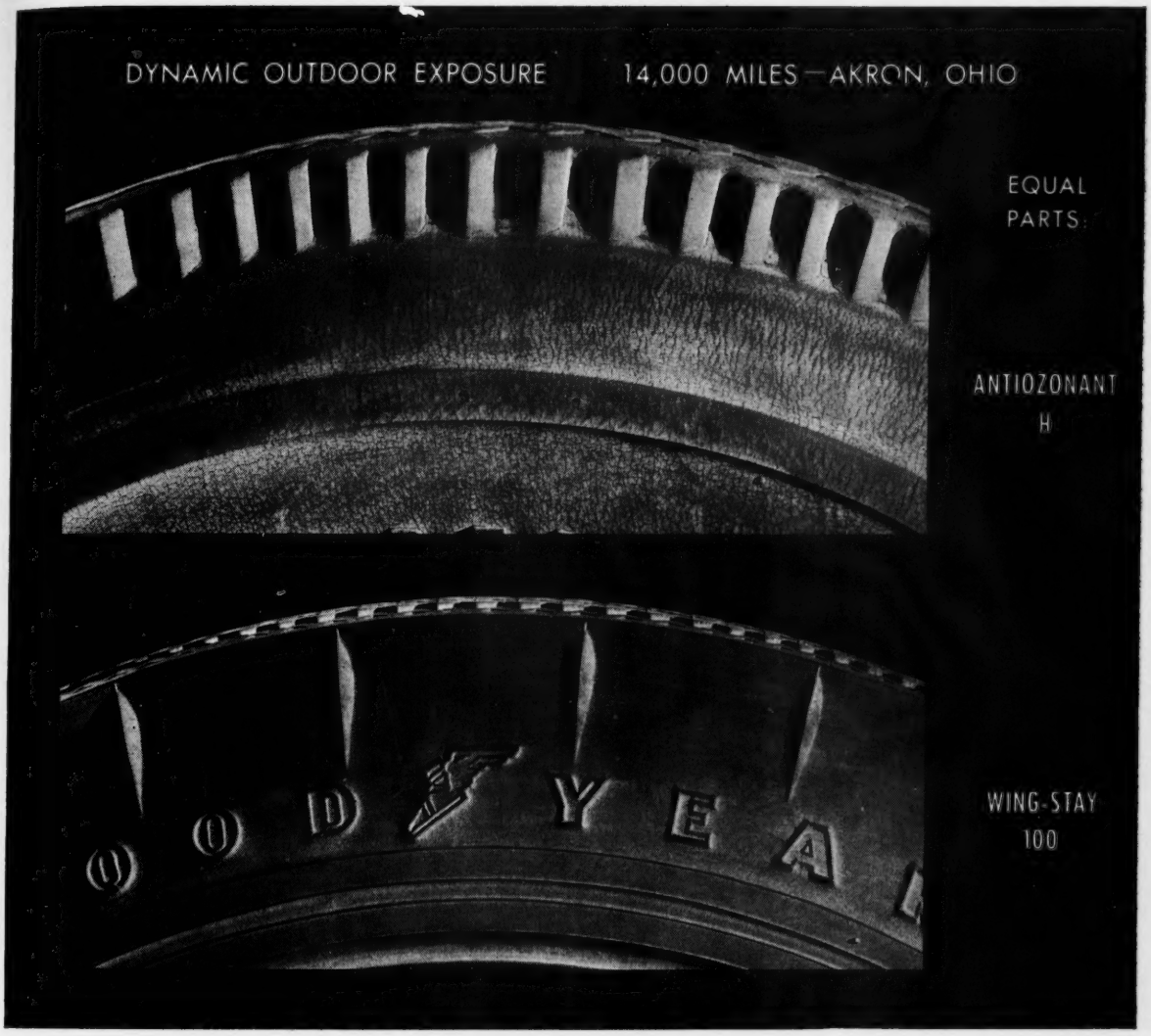
L. M. WHITE
Director, Research and
Development Department,
United States Rubber Co.,
Wayne, N. J.

April 14, 1959

DEAR SIR:

I enjoyed the article, "Trends in Rubber Research," by A. V. Tobolsky, in your March issue. It would appear that he has done a commendable job of summarizing the basic polymer requirements of today and the foreseeable future.

(Continued on page 288)



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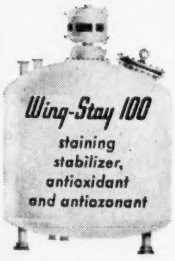

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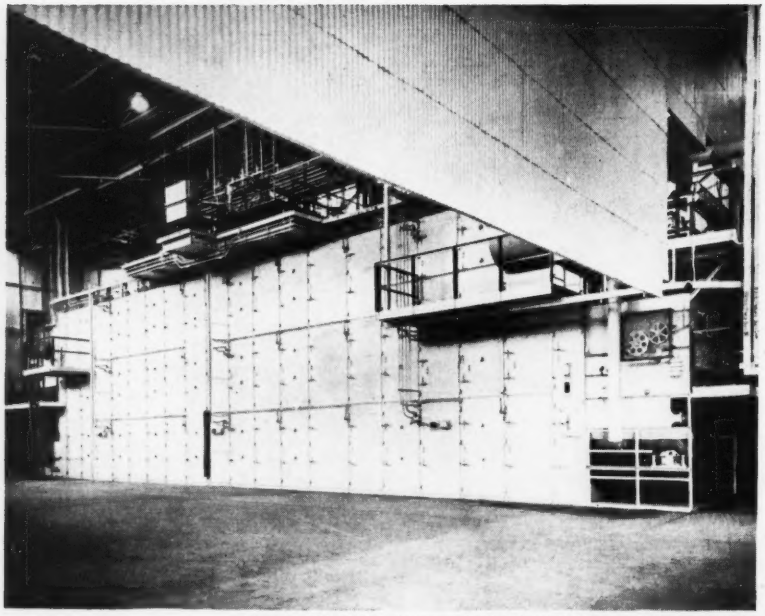

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June 4
New York Rubber Group. Outing. Doerr's Grove, Milburn, N. J.

June 5
Fort Wayne Rubber & Plastics Group. Outing. Tippecanoe Country Club, Leesburg, Ind.

Quebec Rubber & Plastics Group. Outing.

June 5-6
Southern Rubber Group. Desert Ranch, St. Petersburg, Fla.

June 6
Southern Ohio Rubber Group. Outing. Inland Activities Center, Dayton, O.

June 9
Buffalo Rubber Group. Golf Outing. Lancaster Country Club, Buffalo, N. Y.

June 12-14
Rhode Island Rubber Club. Twenty-Fifth Anniversary Outing. The Belmont, West Harwich-by-the-Sea, Mass.

June 15-19
American Society of Engineering Education. Pittsburgh, Pa.

June 19
Akron Rubber Group. Outing. Firestone Country Club.

Boston Rubber Group. Outing. Andover Country Club. Andover, Mass.

June 22-26
American Society for Testing Materials. Annual Meeting. Atlantic City, N. J.

June 26
Detroit Rubber & Plastics Group, Inc. Outing. Western Golf & Country Club.

July 24
Chicago Rubber Group Golf Outing. St. Andrews Country Club.

August 4
New York Rubber Group. Golf Tournament. Forsgate Country Club. Jamesburg, N. J.

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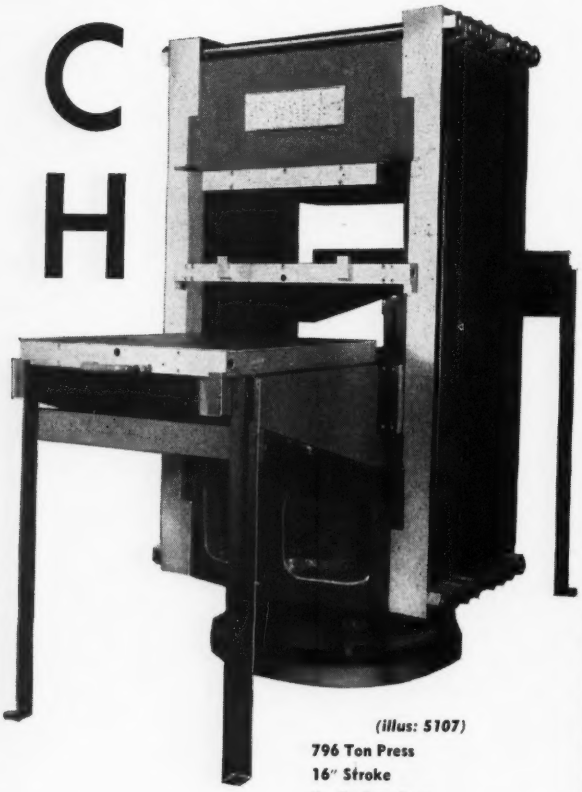

(illus: 5107)
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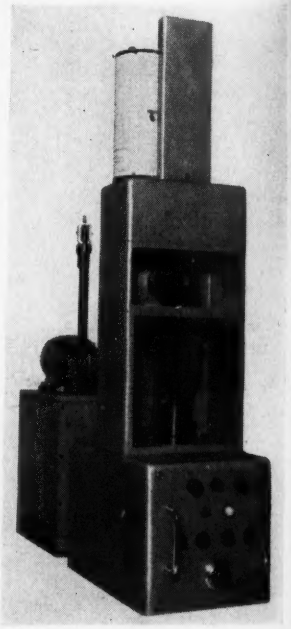
NEW EQUIPMENT

Bayer Vulcameter in U. S.

A new testing apparatus for the automatic recording of the vulcanization curve of natural and synthetic rubber compounds is now available to the American rubber industry. This instrument, called the Vulcameter, was developed by Farbenfabriken Bayer A.G. Laboratories, Leverkusen, Germany, and is available from Brinkmann Instruments, Inc., Great Neck, L. I., N. Y.



Bayer Vulcameter

The machine is reported to provide in one simple test and operation the information on state of cure now obtained by both stress-strain curves and by the Mooney viscometer method. The curve obtained with the Vulcameter represents a continuous measurement in relation to elapsed time of the reaction to stress of the sample at various stages of vulcanization. Thus with this apparatus the determination of the conditions for partial, total, or over cure can be made with considerable economies in regard to time, expense, and materials.

The Vulcameter requires only a small amount of material which is placed between two plates which serve as object holders and are double-jacketed for maintaining temperatures up to 200° C. for extended periods of time. Dynamic shear stress is induced in the sample by an eccentric drive which displaces the upper part of the clamp at a very low frequency a distance of 0.1-millimeter. The lower clamp is supported by an electrical dynamometer which measures the shear load on the sample and transmits it to a recorder. The low frequency is chosen to permit values to be obtained in the plastic range where deformation exceeding flow rate might distort the results.

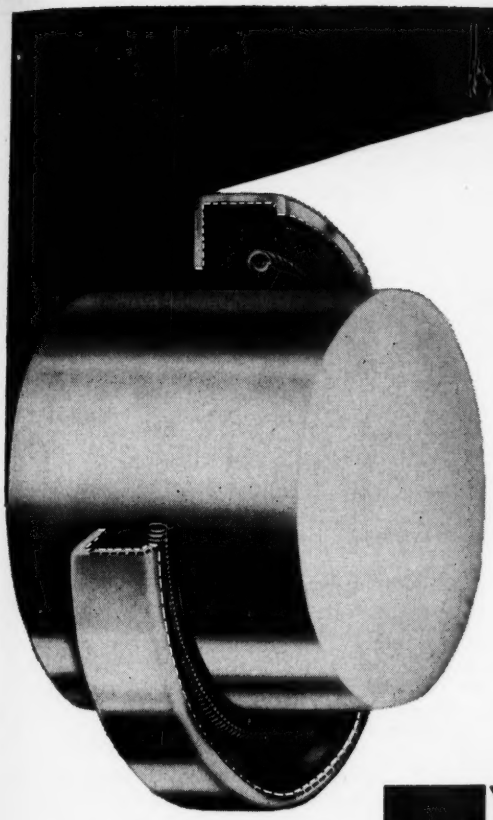
This test gives a complete vulcanization curve and is claimed to be very close in correlation to a curve obtained by time-temperature cures and Mooney viscometer scorch values. The test is described as fast with good reproducibility and together with the equipment is described more fully in *Kautschuk und Gummi*.[1]

[1] July, 1957, p. 168WT; June, 1958, p. 159WT.

New Meter for Cutters

The Motch & Merryweather Machinery Co., Cleveland, O., manufacturer of Wink cutting machines, has introduced a new metering unit to control cutting length on its model M420 Wink universal cutting machines and M400 Metoveyors.

The new device features a new large, easy-reading dial, graduated in feet and inches. A separate scale for each three



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Why TY-PLY in C/R* oil seals?

*Chicago Rawhide—recognized leader in the sealing field—specifies TY-PLY for bonding the flexible sealing member to metal case in HD, HM and HMS Oil Seals. C/R reports the bond is completely permanent, enabling seals to deliver dependable, trouble-free performance. TY-PLY meets the widest variety of rubber-bonded applications—defies all shear, tension and compression forces—fulfills toughest static, dynamic and chemical requirements.

TY-PLY will adhere most vulcanizable rubber compounds to almost any clean metal surface.

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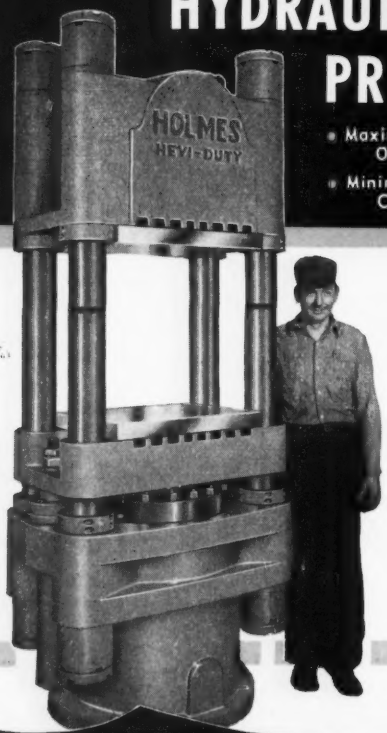

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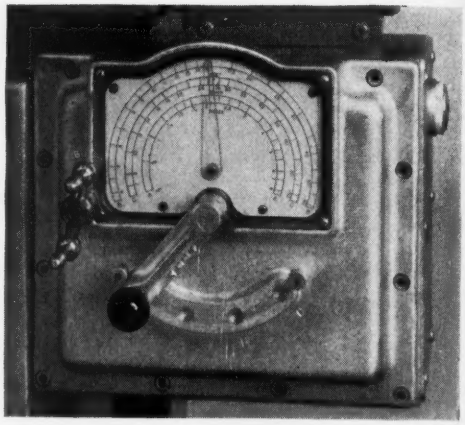


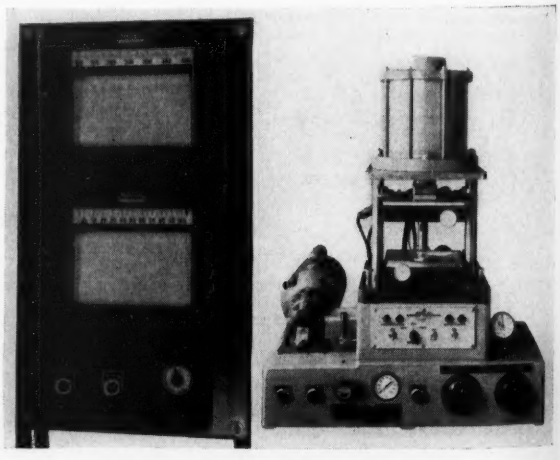
Cutting length control meter

length ranges is provided. Length selection is quick and precise by the sturdy hand-crank, reports the manufacturer. Backlash is automatically compensated for, and length changes may be made while the machine is in operation or idle. Standard cutting capacity is from ½-inch to 60 feet. Almost any desired range is available.

In addition to precision and convenience of operation, the new metering unit is designed for long precision life. The function of the device is to operate the clutch escapement mechanism on the Wink machine by electric impulse when precisely the preset length of material has been measured. It is available on machines now in the field.

Automated Viscometer

Automated operation of its Mooney viscometer is announced by Scott Testers, Inc., Providence, R. I., with the claim that 75% of the operator's time may be saved thereby. This saving is made possible by the fact that after the operator inserts the test specimen and sets the controls, the machine takes over and completes the viscosity test automatically. The controls are preset to shut off after a specified time lapse and/or at a specified viscosity. After the specimen has been inserted, and the start button pushed, the automatic cycle follows: (1) a one-minute warm-up takes place; (2) the test proceeds, and results are recorded; (3) the test is shut off on the basis of elapsed time



Recording elements (*left*) for Scott automated viscometer

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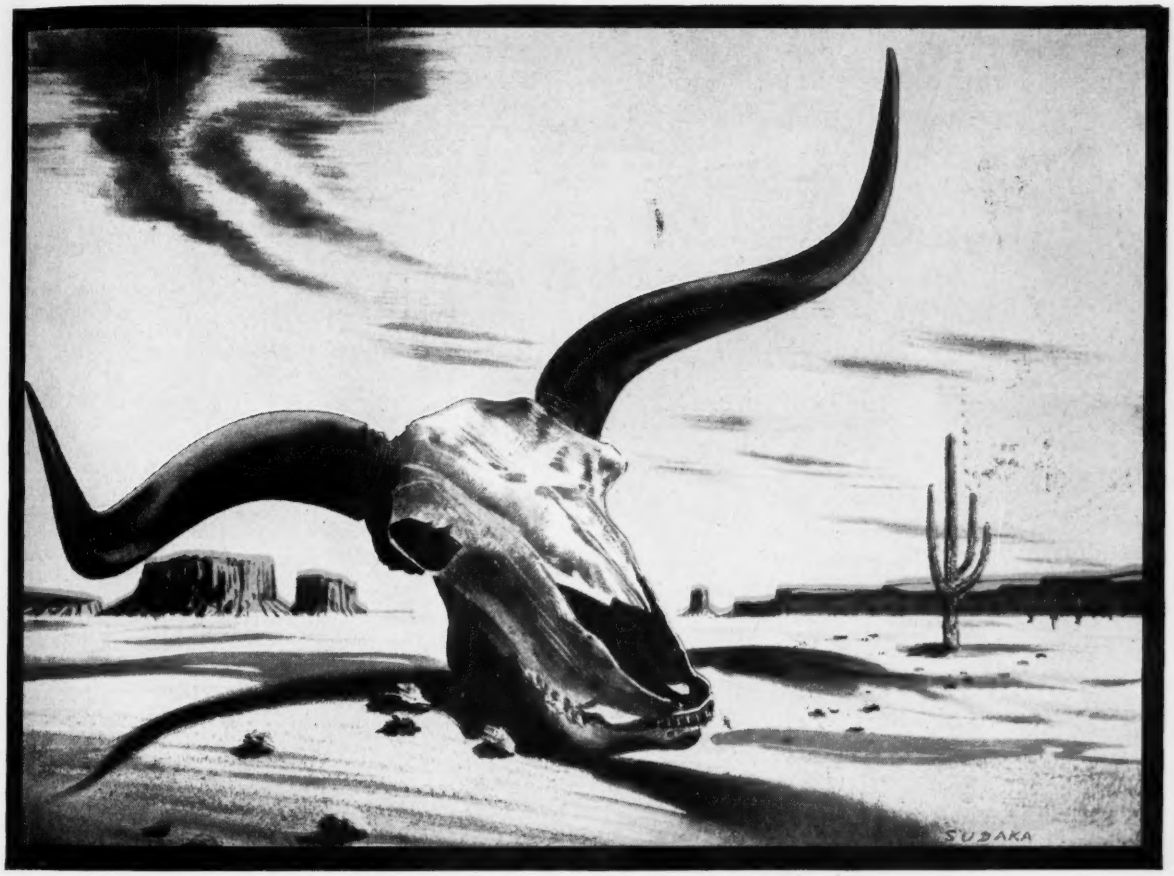

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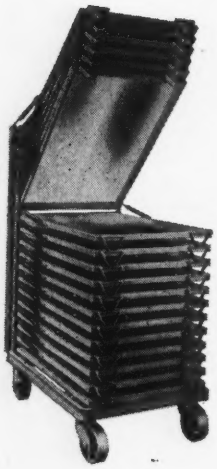

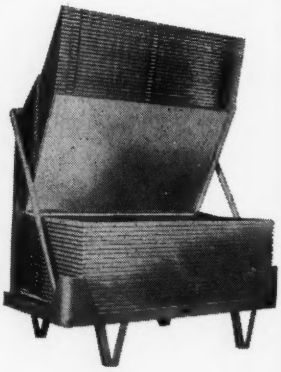

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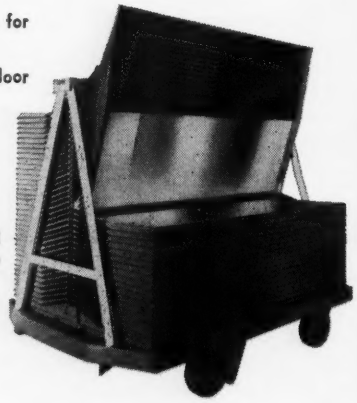

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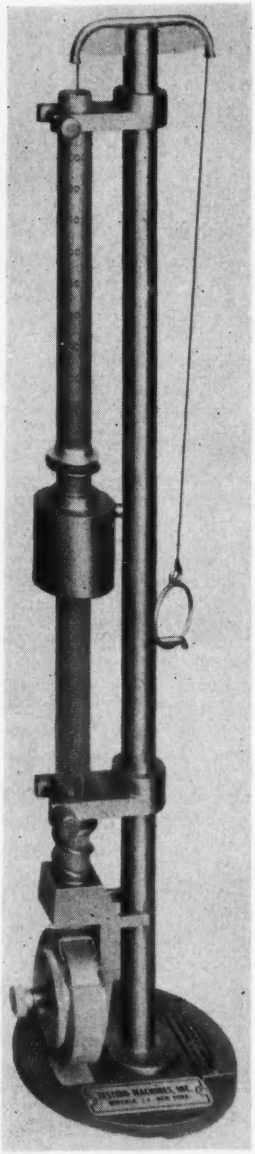
New Equipment

or viscosity rise—both can be operable, so that whichever occurs first governs; (4) automatic recording of the test has concurrently taken place on the visual chart showing viscosity on the vertical scale and elapsed time on the horizontal. Temperature is also recorded in synchronization.

The new Scott automated feature is applicable to both models STI and NBS which yield Mooney point values strictly in accordance with ASTM standards. Further information can be obtained from the company.



New Dunlop Tackmeter

Portable Tackmeter

Testing Machines, Inc., Mineola, L. I., N. Y., is distributing the Dunlop Tackmeter, an instrument for assessing surface tack numerically. It was developed at the Dunlop Research Center for the measurement of tackiness in the rubber industry and is suitable for process control and laboratory development work.

This device is typically used in the rubber industry for measuring the tack of rubbered fabric to itself or to uncured rubber sheet and for estimating the tack of dipped cords to uncured rubber. The principle of the Tackmeter results in a close reproduction of the actual conditions likely to be experienced in practice, according to TMI. This instrument is designed, moreover to accommodate the range of tackiness normally associated with such materials as above, but can be modified to suit surfaces which are less tacky or tackier.

Essential parts of the Tackmeter are the wheel which carries the six-inch by ½-inch test strip round its circumference; the calibrated spring which measures the separating force; and a weight to press the surfaces together. An aperture in the base allows contact between the test strip attached to the wheel and the sheet of material upon which the instrument is standing. The scale measuring the extension of the calibrated spring is marked on the cylindrical body of the instrument and is graduated in grams. A rider indicates the tack in grams on the scale after the surfaces of the tested materials have separated.

The Tackmeter, which is hand operated and easily portable, assesses the tackiness of a surface from measurements which are normally carried out at ten chosen points of the surface without damaging the surface. The instrument, robust and attractively finished in chromium plate and stoved enamel paint, is supplied in a fitted metal carrying case.

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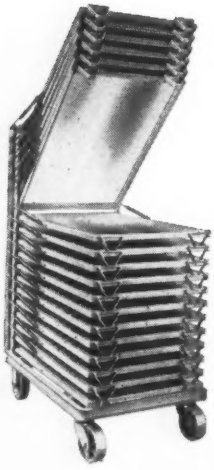

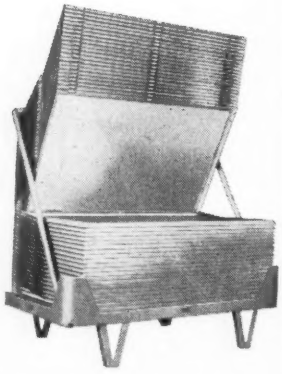

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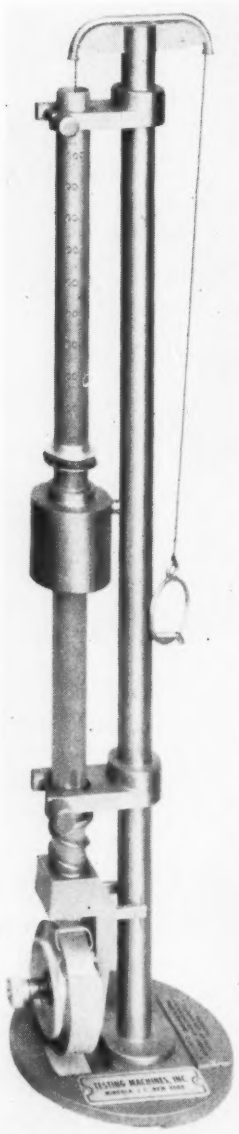

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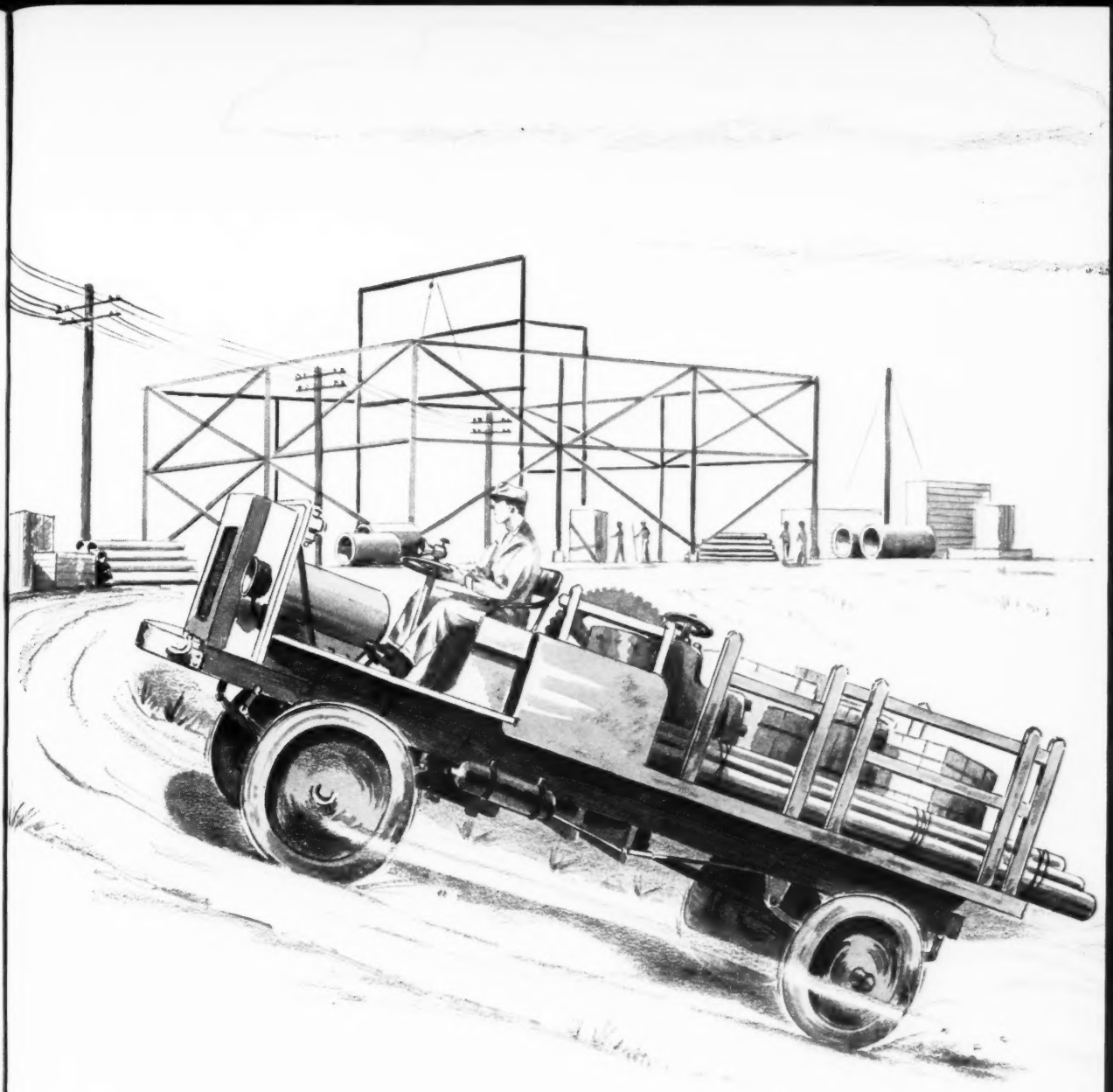

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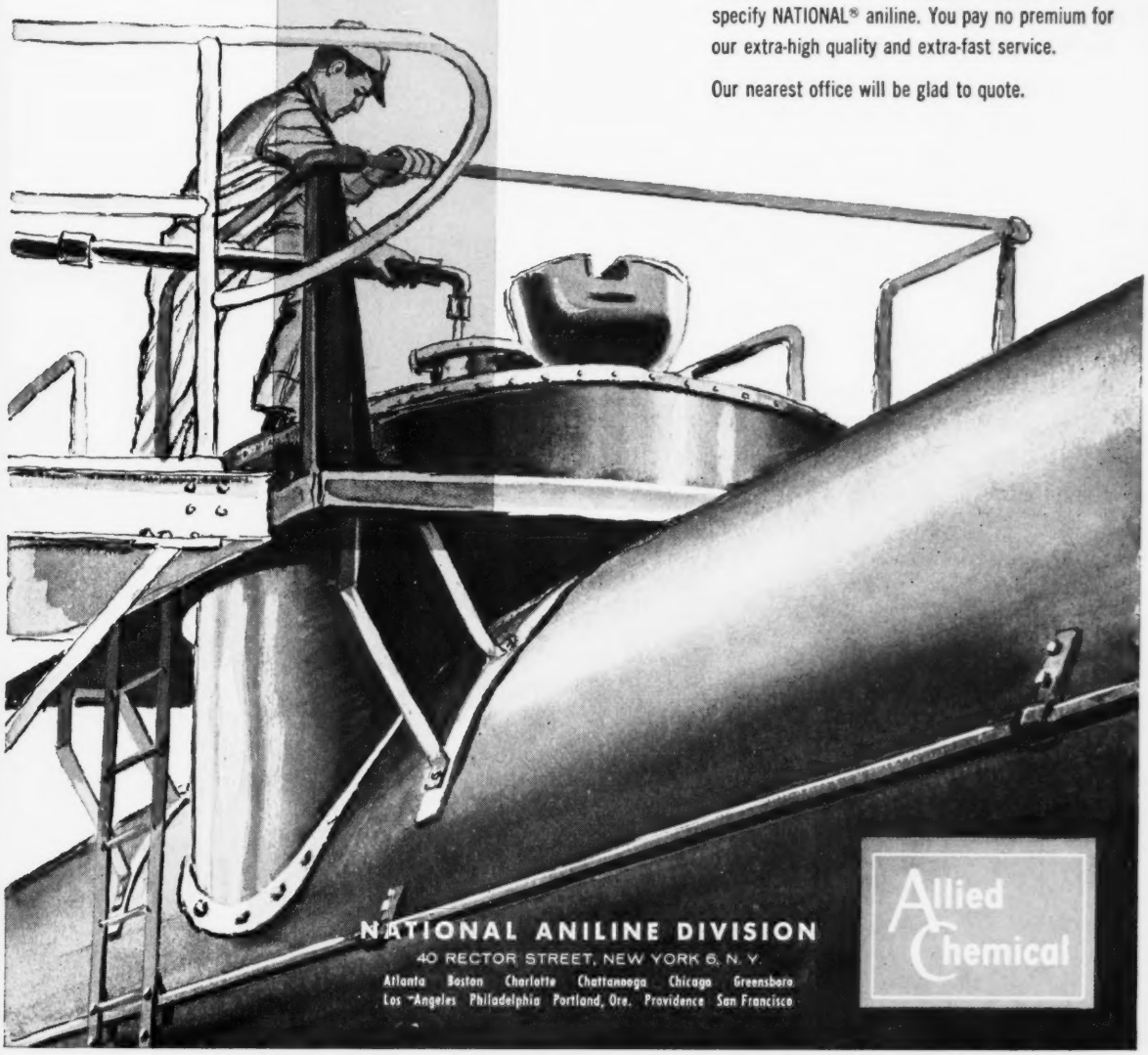

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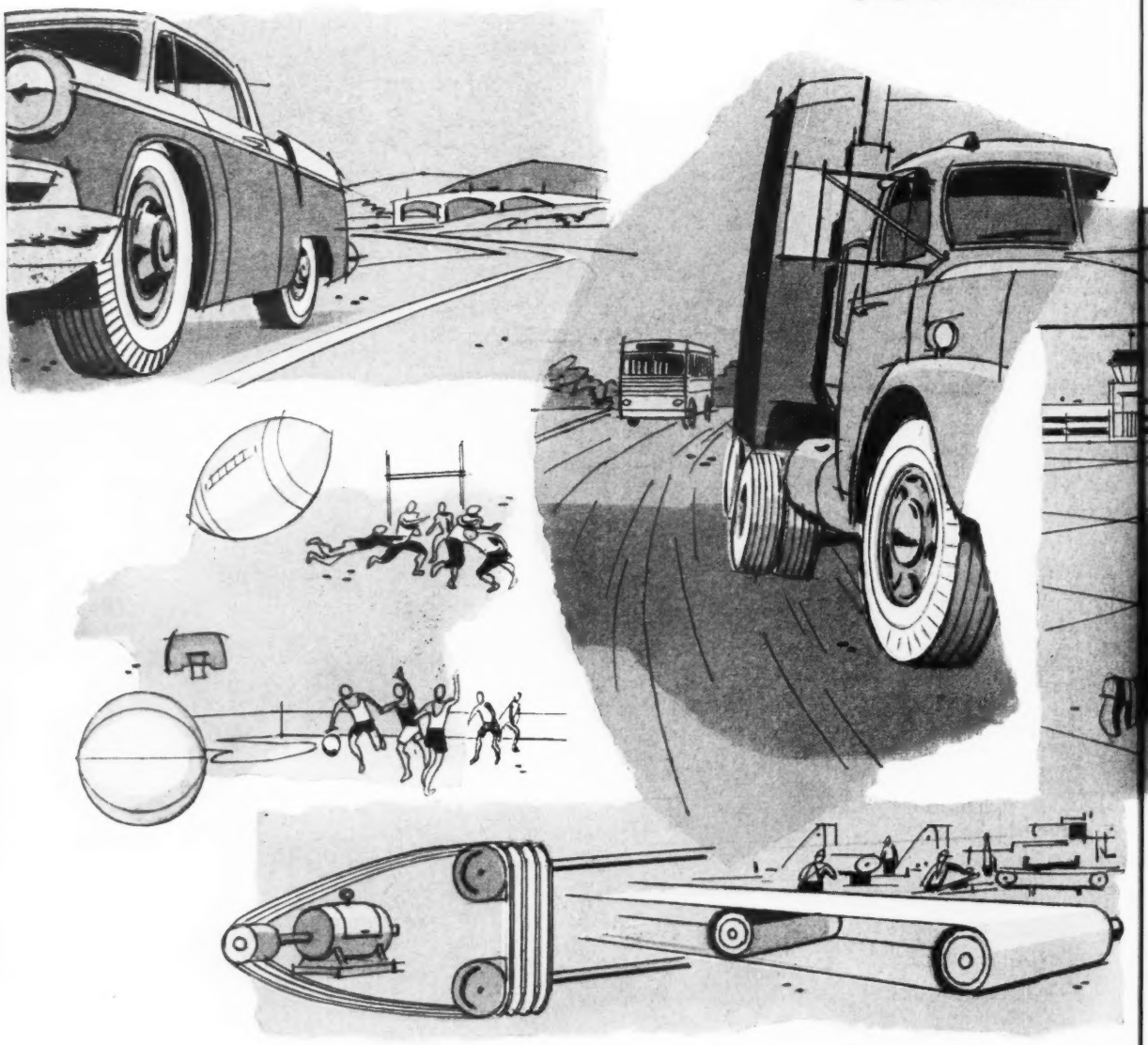

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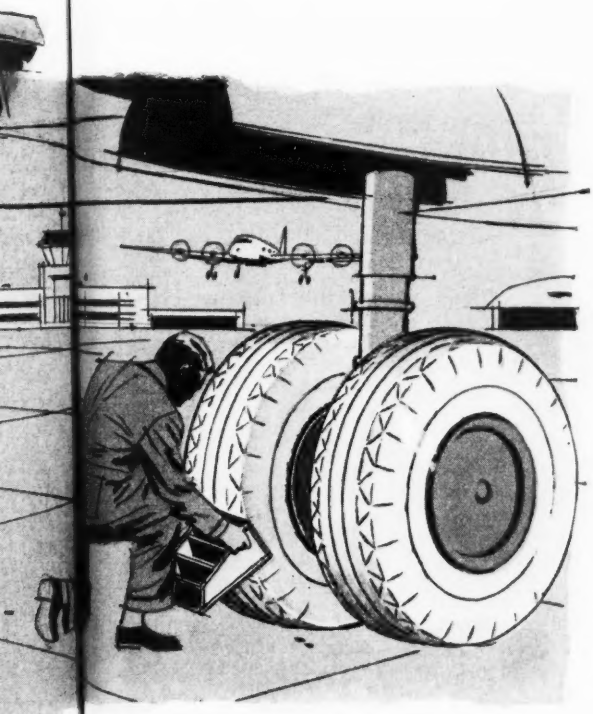

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TECHNICAL BOOKS

BOOK REVIEWS

"Organic Chemistry of Bivalent Sulfur." Volume I. E. Emmet Reid, Professor of Chemistry, Emeritus, Johns Hopkins University. Cloth, 5½ by 8½ inches, 539 pages. Chemical Publishing Co., Inc., New York, N. Y. 1958. Price $20.00.

This first volume augurs well for a proposed five-volume series that will fill a long-standing need in the literature of the organic chemistry of sulfur. It consists of five chapters which treat mercaptans, reactions of mercaptans, negative derivatives (substitution at the sulfhydryl hydrogen), substituted mercaptans (substitution in the alkyl or aryl portion), and mercapto-acids (e.g. mercaptoacetic or thioglycolic acid, $HSCH_2COOH$; thio-acids such as thioacetic, CH_3COSH, will be covered in volume IV).

For each class of compound there are presented a description of the applicable syntheses, a survey of reactions and uses, and finally a table of physical properties for as many as several hundred members of that type of compound. Many of the preparative procedures are discussed critically, but Professor Reid has wisely declined the formidable task of resolving conflicting reports of physical properties. Instead the technique of Beilstein's *Handbook* is used, in which all reported values are cited with references to the original literature.

The literature search for this volume is generally complete through 1954 and has produced more then 4,400 references. The 31-page index is based on the inverted nomenclature system familiar to users of *Chemical Abstracts*, thus listing together chemically related compounds.

The book is an attractive one, having large clear printing on a good quality paper. There is a liberal use of chemical equations to illustrate the text. In general, each equation is set as a single line of type, using empirical or condensed structural formulas. Where required for intelligibility, expanded structural formulas have been used.

A book of this scope must be written in a cursive style to maintain a reasonable size, but occasionally the results are not so clear as might be desired. For example, on page 270 it is stated ". . . 2,4-dinitro [benzene] sulfenyl chloride is used as a reagent." Even in context it is not apparent that the reagent is one for preparing derivatives of olefins.

Workers in the field of rubber chemistry may find this volume lacking in treatment of the formation of sulfides from mercaptans and hydrocarbons. For example, no mention is made of Cunneen's addition of mercaptans to rubber and rubber model compounds in the chapter dealing with the reactions of mercaptans. The reason for this omission, as stated by Professor Reid on page 107, is that "where the products of a reaction are the subject matter of a later chapter the reaction itself is not considered in this chapter [on reactions of mercaptans]."

The topic cited above may thus be expected to appear in Volumes II and III, which will treat sulfides. The reviewer is looking forward to the publication of these subsequent volumes.

DOUGLAS I. RELYEA

"Technical Editing." Edited by B. H. Weil. Cloth, 5⅛ by 7½ inches. 278 pages. Reinhold Publishing Corp., New York, N. Y., 1958. Price $5.75.

This book presents in one place the technical editing principles for the first time. More than 20 contributors, all leading authorities, have provided excellent guidance for both the experienced and the beginning editor.

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FR-S 176 is another Firestone polymer designed to provide specific product characteristics and manufacturing economies. Firestone Technical Service stands ready to help you choose exactly the right synthetic rubber or latex for the job from the largest and most complete line of product-specialized polymers in the industry. Write today. *Firestone Synthetic Rubber and Latex Co.*, Akron 1, Ohio.

Firestone

BETTER RUBBER FROM START TO FINISH

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of technical people in communicating. Most of this, however, concentrated on improving the source preparation of technical documents. Along with this awareness of the need of good technical communications, the group classified as technical editors has been greatly expanded. This group has always been in existence as the professionals associated with the technical books and journals and also as the supervisor who had to approve a report or paper, but now includes people in all technical areas. Presented here are the phases of technical editing needed by the growing group of technical men and women devoting full-time to the improvement of "internal" technical communications.

Information is provided to set publication standards, provide writing guides, review documents and reports for proper presentation, editing graphic aids such as slides and charts, and even includes "technical publishing." Anyone interested or concerned with technical communication in government, education, industry, professional societies, or trade groups will find much helpful information in this book.

NEW PUBLICATIONS

"Recent Developments in High Density Polyethylene Insulating Materials." Union Carbide Plastics Co., division of Union Carbide Corp., New York, N. Y. No. 106. 11 pages. This bulletin examines in detail two Bakelite polyethylene insulating compounds—DFD-2005, a typical low-density resin; and DGDA-5100, the newest Bakelite high density polyethylene. Physical and electrical properties, stress cracking resistance data, typical mechanical properties, and typical thermal embrittlement data are included. Graphs and tables also are presented.

"LE-HI Condensed Catalog No. 34." Hose Accessories Co., Philadelphia, Pa. 8 pages. This profusely illustrated catalog contains information on the wide variety of LE-HI hose couplings and fittings for every type of industrial rubber hose. It also incorporates description and illustration of several new items recently added to this line.

"Web Process Engineering." General Catalog No. 10. John Waldron Corp., subsidiary of Midland-Ross Corp., New Brunswick, N. J. 128 pages. This fully illustrated catalog is designed to acquaint converters of paper, plastics, metals, textiles, and rubber with the company's service in connection with projects involving coating, saturating, laminating printing, or embossing operations. The mechanical and auxiliary equipment required in a completely modern web processing line are described. Other subjects covered include the Waldron experimental laboratory and other Midland-Ross divisions such as the Waldron coupling division and Hartig extruders.

"59 Ideas for Modernization in '59." Allis-Chalmers Mfg. Co., Milwaukee, Wis. 20 pages. Examples of modernization ideas listed in this booklet include such topics as ball and grinding mills, induction heating, motor, regulator and transformer data, dielectric heater, speed control, and many other useful suggestions. Many of these specific items have been reported in the past, but, in this booklet, are published together and are available from the company.

"Radiation Dynamics." Radiation Dynamics, Inc., Westbury, L.I., New York. 4 pages. This bulletin describes RDI's new irradiation center which contains two separate vaults with Dynamitron electron accelerator units of 1 mev., 2 kw. and 1.5 mev., 15 kw. output. Both units are available for contract work on a single or sustained basis. In addition, research assistance can be provided by the firm's technical staff if desired by the contractor.

"DIBS Accelerator." American Cyanamid Co., Bound Brook, N. J. 4 pages. This is a new data sheet on the company's DIBS accelerator, an outstanding delayed-action accelerator, particularly effective with high abrasion furnace blacks in natural rubber and SBR copolymers. General chemical and physical properties of DIBS (N,N-diisopropylbenzothiazole-2-sulfenamide), specifications, compounding characteristics, uses, and analytical test methods are included.

"Specifications and Characteristics of Organic Chemicals." Emery Industries, Inc., Cincinnati, O. 4 pages. This catalog lists product designations, descriptions, and specifications for Emery's organic chemicals including such materials as fatty acid esters; Empol dimer acid; Emerox azelaic acid; Emfac pelargonic, capric, and caprylic acids, all for use in rubbers and plastics; and Emolein esters for synthetic lubricants; Plastolein vinyl plasticizers.

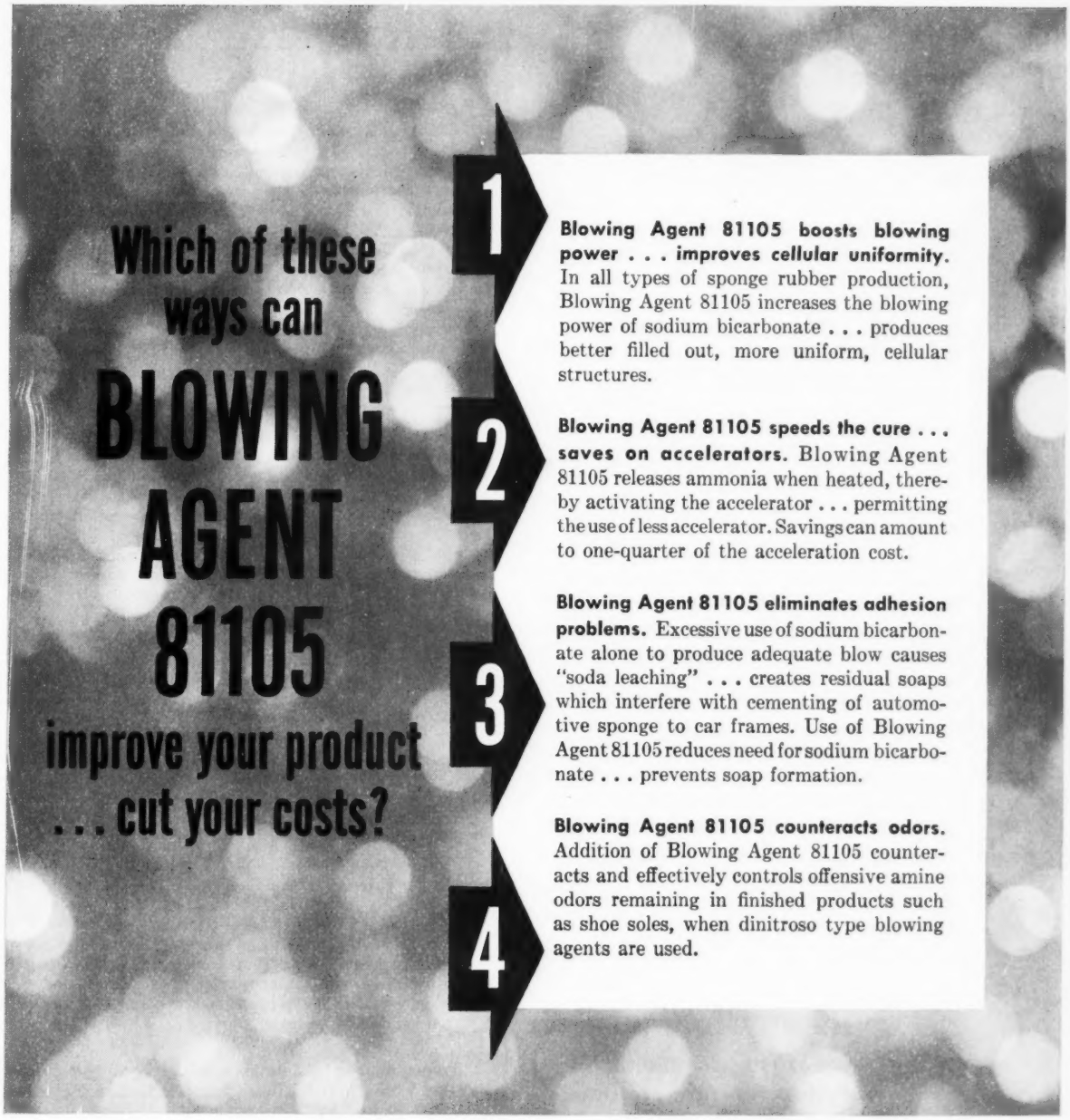
"ASTM Standards on Plastics." American Society for Testing Materials, Philadelphia, Pa. 1,108 pages. Paper cover, 6 by 9 inches, $8.00. To this edition 43 standards, not appearing in the 1957 edition, have been added. Significant new standards include specifications covering dimensions of SWP and IPS sizes for (D 1593); glass-fabric reinforced epoxy resin laminates (D 1592); and polymethylstyrene molding and extrusion material (D 1595). New data include a group of standards on plastic pipe with specifications covering dimensions of SWP and IPS sizes for cellulose acetate butyrate, and acrylonitrile-butadiene-styrene pipe. Also included are methods for short- and long-term hydrostatic pressure tests of plastic pipe. Included in this edition are tentative abbreviations of terms relating to plastics (D 1600); for example: acrylonitrile-butadiene-styrene plastics in the new notation are simply ABS plastics. All of the 191 ASTM standards applicable to the plastics industry are given.

"Sure-Flex Flexible Couplings." Bulletin No. 10100A. T. B. Wood's Sons Co., Chambersburg, Pa. 8 pages. This revision covering the company's Sure-Flex couplings now includes 10 sizes. The additions are: No. 3 (⅜- to ¾-inch bore), No. 4 (½- to one-inch bore), No. 11 (1⅞- to 2⅝-inch bore), and No. 12 (2⅜- to 2⅞-inch bore). Selection data and other engineering tables have also been revised. These tables also include newly designed couplings with ductile-iron flanges and a special steel retaining ring and specially balanced couplings.

"Universal Worm Gear Speed Reducers." Folder 2724. Link-Belt Co., Chicago, Ill. 8 pages. This folder contains complete data on a new type of reducer that is designed to operate in three different positions and has a higher capacity with external fins for cooling. The folder illustrates the various mounting positions and contains selection procedures for proper applications. Five tables give service factors, load classes, input horsepower ratings, overhung load ratings, and thrust load ratings. Dimensions and weights for all three mountings are also graphically described.

"RTV Silicone Rubber." Silicone products department, General Electric Co., Waterford, N. Y. 8 pages. This bulletin describes RTV-20, RTV-60, and RTV-9 the company's (room temperature vulcanizing) silicone rubbers, recommended for electrical potting and encapsulating, for flexible mold-making materials, and for high- and low-temperature sealing and calking. It includes complete product and application data for three new RTV compounds, listing their advantages as better physical properties and heat resistance, over previously available RTV curing elastomers. Included also is information on 81822 Primer for bonding RTV rubbers.

"Ideas in Development." Vol. 2, No. 4. Armour Chemical Division, Armour & Co., Chicago, Ill. 10 pages. Of interest to the rubber chemist is a section in this booklet describing MD 738, an ultra-violet light stabilizer. Experiments with MD 738, a high molecular weight amino compound, have indicated the chemical's usefulness as an ultra-violet light stabilizer in natural and synthetic rubber. The chemical exhibits antioxidant properties, is non-staining, and will not affect the rate of cure.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Technical Books

Publications of Thiokol Chemical Corp., Trenton, N. J.:

"Additives for Improving Butyl's Ozone Resistance." Bulletin 105-1. 12 pages. This bulletin evaluates the effect of antiozonants, antioxidants, sunproofing waxes, and other materials as additives for improving the ozone resistance of butyl rubber compounds. The effects of these various additives are presented in tabular form.

"Study of the Effects of High Aromatic Fuels on Elastomers." 12 pages. This is a report based on a recent study comparing the effects of high aromatic fuels on oil-resistant elastomers. The test data shown indicate that the trend to higher aromatic hydrocarbon levels in fuels is a significant factor in compounding rubber goods to obtain the required fuel resistance and performance. The test results were obtained by evaluating seven rubber types in fuels varying in aromatic concentrations up to 100%.

"Questions and Answers on Electron Microscopes." Philips Electronics, Inc., Mount Vernon, N. Y. 12 pages. This booklet compiled from actual queries asked in the field and at Norelco microscope school sessions, discusses magnification, resolution specimen preparation, and fields of application. Shadow casting electron diffraction, camera work, stereo techniques, astigmatism correction, lens details, beam wobbler, through-focus control, and other technical matters are covered.

"Isobutylene—Its Present and Potential Uses." Petro-Tex Chemical Corp., Houston, Tex. Chart plus 2 pages. This comprehensive family-tree type of chart on isobutylene graphically shows present commercial uses and all reported reactions having potential new-product significance. Accompanying this 17- by 22-inch chart is a bibliography of 213 literature references, keyed to the chart. Petro-Tex has recently come on stream with the first major, non-captive production of 99+% isobutylene for which the firm believes there is a broad spectrum of non-rubber new uses.

"How to Inhibit Sulfide Staining of Pearl Vinyl Products." No. 50. Claremont Pigment Dispersion Corp., Roslyn Heights, L. I., N. Y. 1 page. This technical data sheet describes two stain-resistant essences suitable for incorporation in vinyl compounds: Lo-Stane Non-Lead Pearl or D-6052 and Lo-Stane Lo-Lead Pearl or D-6426. These materials are said to eliminate the problem of vinyl products, pigmented with synthetic lead-type pearl essences, which are known to stain upon exposure to sulfur or sulfur compounds.

"Installation and Maintenance of Resilient Smooth-Surface Flooring." No. 597. Building Research Institute, Washington, D. C. 145 pages. $5.00. This document contains information on the installation and the maintenance of all of the various types of resilient flooring on the market. Included is the report on BRI's preconference survey of flooring problems, and recommendations. There is also a chart which compares physical properties, standard dimensions, installed cost per square foot, and the use level at which each material may perform successfully. In all, this document contains 14 individual reports, two workshop panel discussions, and three appendix sections related to the survey questionnaire.

"Dioctyl Sebacate." No. 116. Harchem Division, Wallace & Tiernan, Inc., Belleville, N. J.

"1959 Product Index." Eastman Chemical Products, Inc., Kingsport, Tenn.

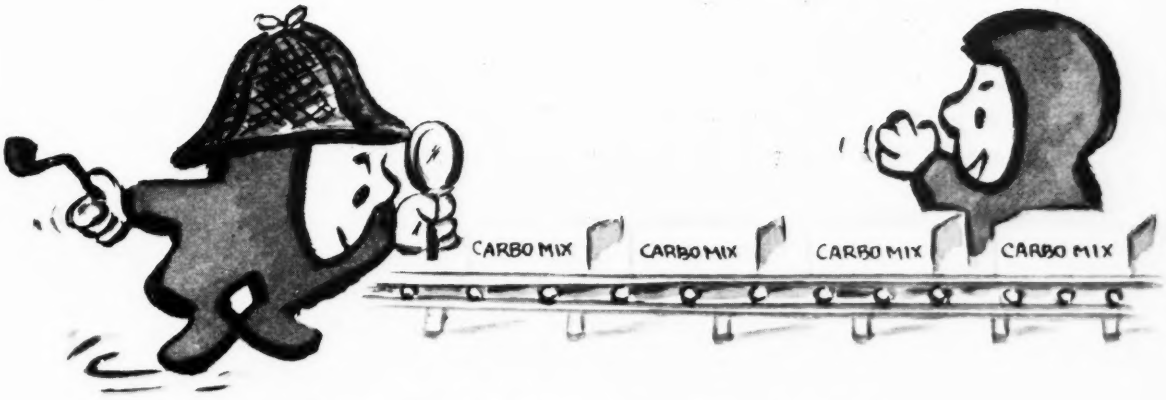
"1959 Directory of Manufacturers' Representatives." Manufacturers' Agent Publishing Co., New York, N. Y.

"B. F. Goodrich Molded Rubber Stair Treads"; "Facts on B. F. Goodrich Koroseal Vinyl Asbestos Floor Tile." The B. F. Goodrich Flooring Products Co., Watertown, Mass.

"Enjay Butyl—The Versatile Modern Rubber." Enjay Co., Inc., New York, N. Y.

"Solid Plasticizers." Monsanto Chemical Co., St. Louis, Mo.

It's elementary, my dear Watson!



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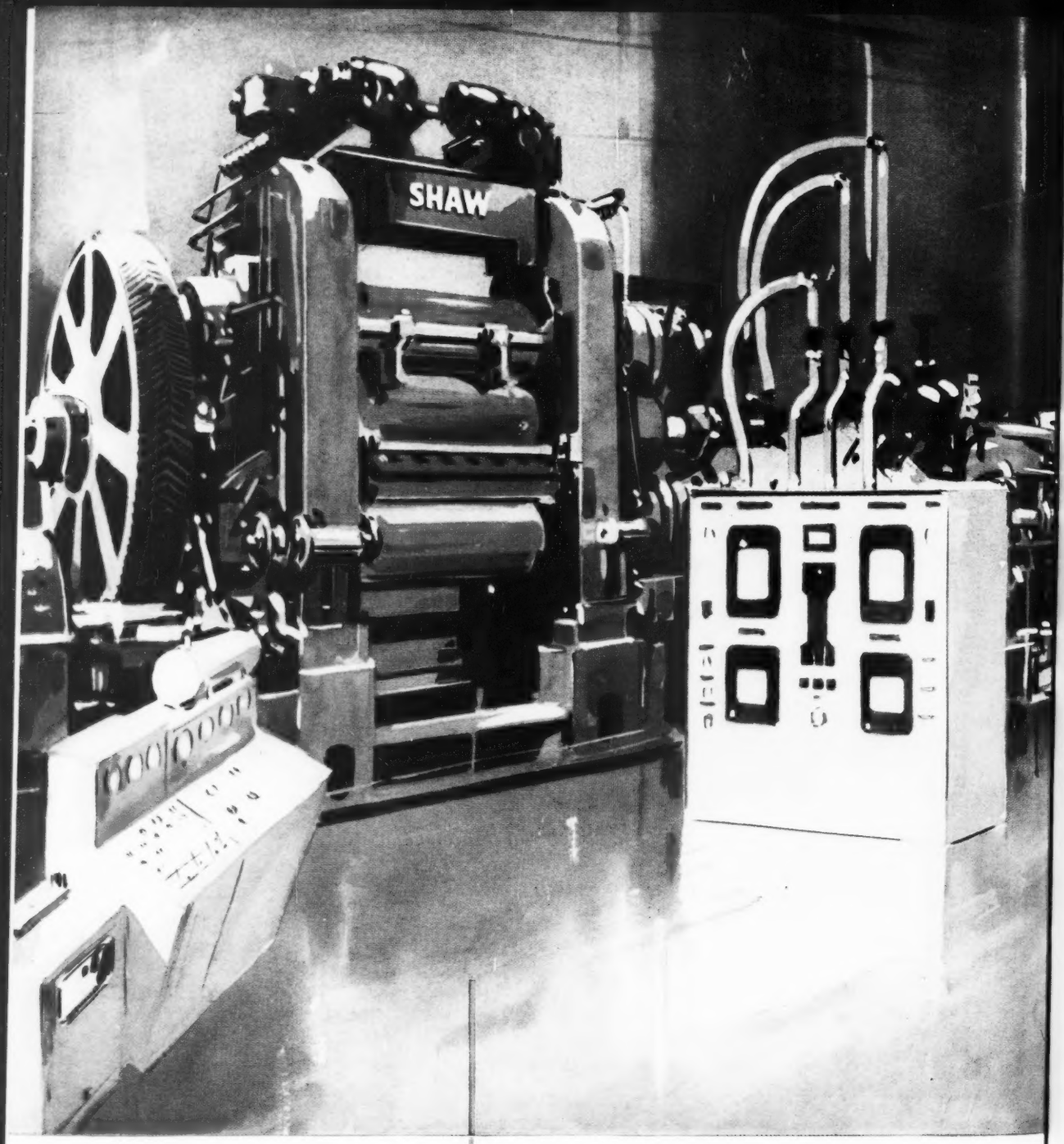

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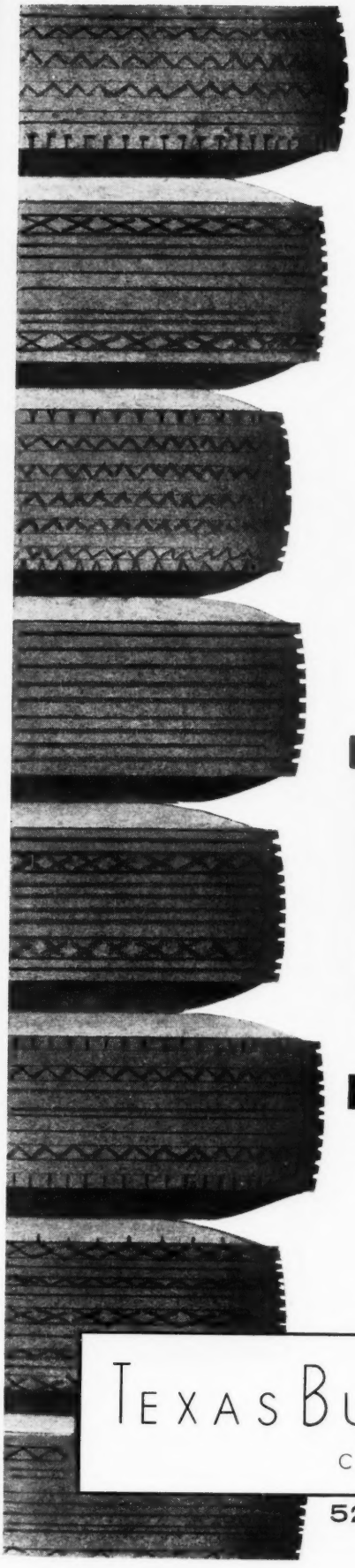

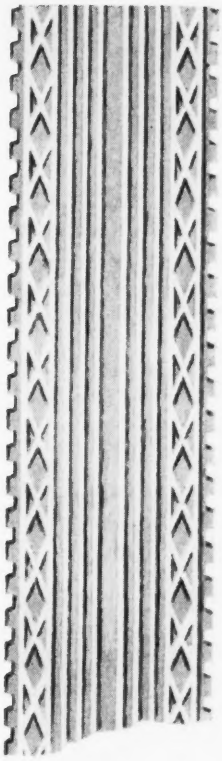

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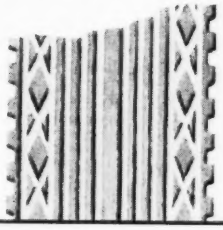

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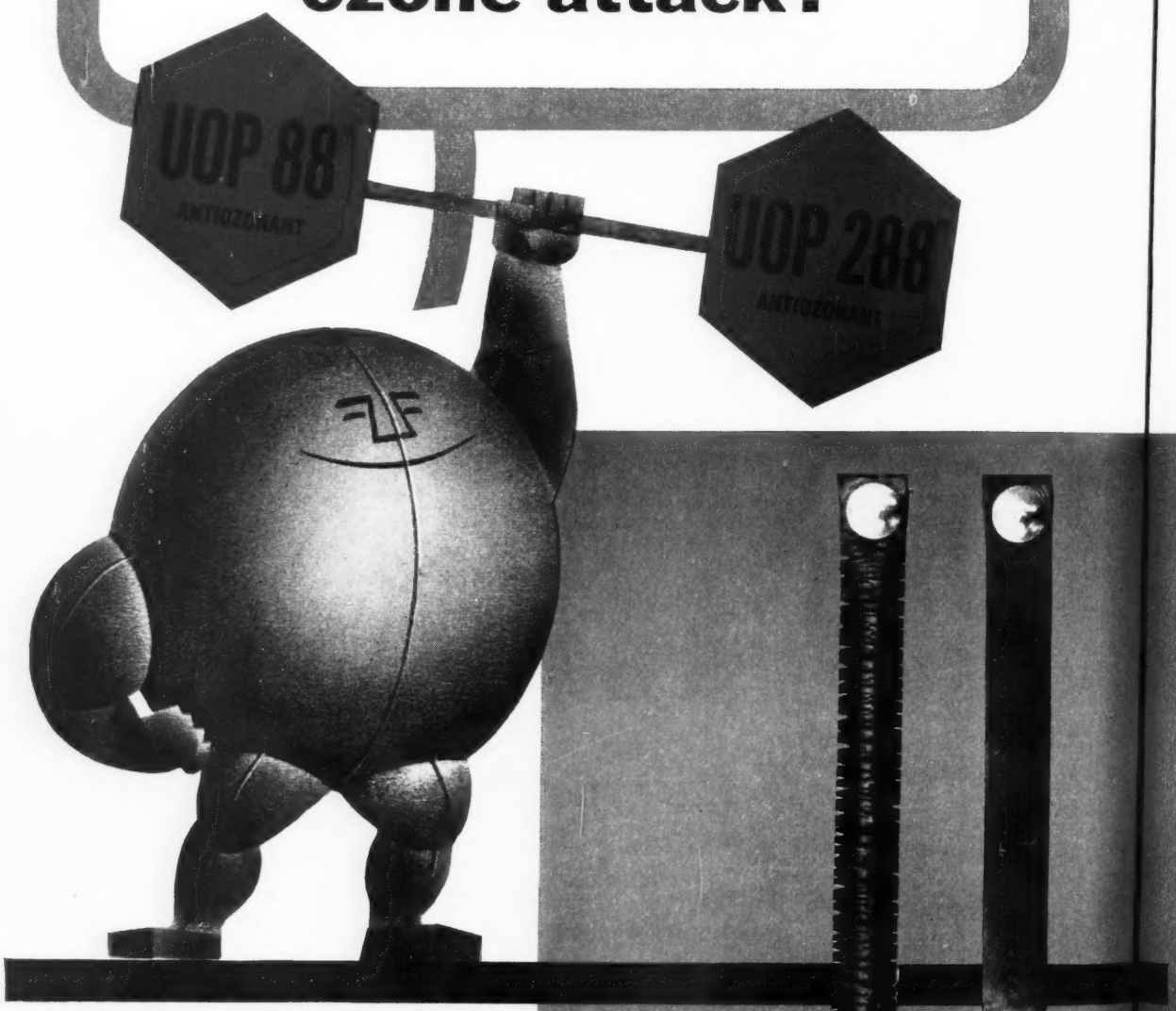

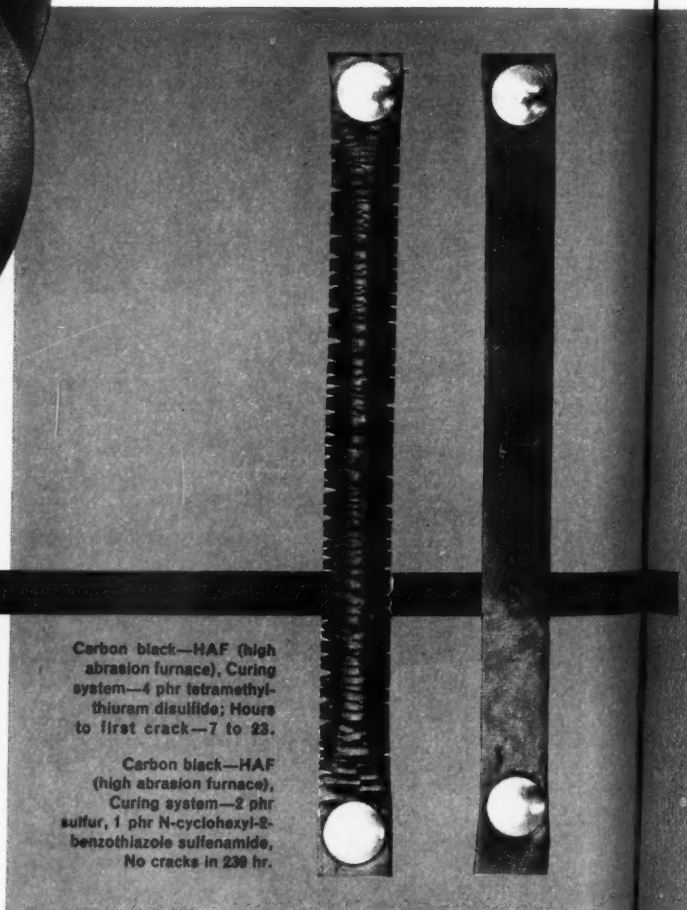

Carbon black—HAF (high abrasion furnace), Curing system—4 phr tetramethyl-thiuram disulfide; Hours to first crack—7 to 23.

Carbon black—HAF (high abrasion furnace), Curing system—2 phr sulfur, 1 phr N-cyclohexyl-2-benzothiazole sulfenamide, No cracks in 230 hr.

The SBR specimens at right were exposed to ozone at 100° F with 20 percent elongation for 52 hr. at 33 pphm ozone, then 187 hr. at 63 pphm ozone.

this key factor, curing, affects antiozonant effectiveness . . .

When you compound rubber with UOP 88 or 288 antiozonants, a versatile chemical barrier continually migrates to the surface, affords sure protection over a long period of time.

But do you realize that the effectiveness of a chemical antiozonant largely depends on your curing system?

Shown below are two rubber test strips which graphically illustrate this point—show the tremendous difference in ozone resistance brought about by differences in curing systems. The accompanying table confirms this fact—shows how the *proper* accelerator aids antiozonant effectiveness.

UOP facilities and technical personnel are available to help you achieve maximum effectiveness in the use of antiozonants. Just write or telephone our Products Department.

Exaggerated conditions of stress and ozone concentration in the oven assure complete protection under any normal conditions.

In the Universal rubber laboratory, a rubber mill is used to incorporate experimental UOP antiozonants in various rubber polymers.

Every day we test a number of rubber recipes. The Scott Tester is used to measure physical properties of an experimental vulcanizate.

Effect of Curing System on Antiozonant Retention in SBR Stocks after Vulcanization

(All contain 3.0 phr UOP 88; 40.0 phr HAF black)

Compound	Accelerator	Sulfur, phr	% Extractable Antiozonant
1082....	2.0 phr benzothiazyl disulfide	2.0	66.4
1083....	1.0 phr benzothiazyl disulfide	2.0	79.6
1087....	None	2.0	~ 100.0
1088....	1.0 phr benzothiazyl disulfide	3.0	74.6
1083....	1.0 phr benzothiazyl disulfide	2.0	79.6
1086....	1.0 phr benzothiazyl disulfide	1.0	88.6
1083....	1.0 phr benzothiazyl disulfide	2.0	79.6
1084....	1.0 phr N-cyclohexyl-2-benzothiazole sulfenamide	—	—
1093....	1.0 phr diphenylguanidine	2.0	~ 18.0
1085....	2.0 phr tetramethylthiuram disulfide	—	35.0
1090....	4.0 phr tetramethylthiuram disulfide	—	12.9

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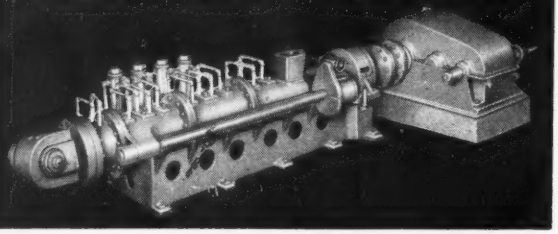

● Now, *you* can use this new process to produce BETTER Reclaimed Rubber FASTER and at LOWER COST!

RECLAIMATOR reclaims have more usable rubber hydrocarbon and are more completely devulcanized than conventional reclaims. They are softer, break down faster and disperse more quickly into the rubber base of a compound. Rubber reclaimed by this method remains plastic and does not age as much, or as rapidly, as old fashioned reclaims. These and many more advantages add up to a higher quality, lower cost rubber for both producer and user.

To learn how you can make BIGGER PROFITS with the RECLAIMATOR, simply write us a letter. Our 75 years of experience in the field are at your disposal.

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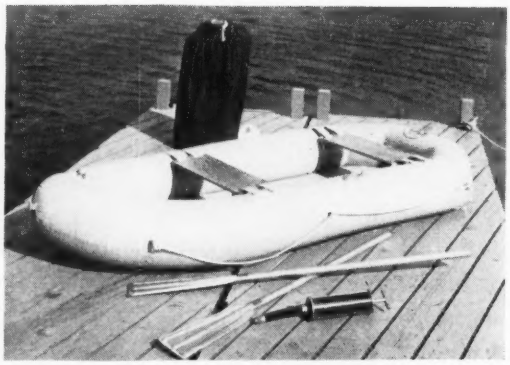
NEW PRODUCTS



U. S. Rubber's duffle bag dinghy

New Inflatable Dinghy

A new inflatable boat that can be stored in a small case has been introduced by United States Rubber Co., New York, N. Y. The new duffle-bag dinghy comes equipped with two folding aluminum paddles, a hand-pump, and two seats. Optional equipment includes a motor mount on which to attach a 1.7-horsepower outboard, and a CO_2 bottle for quick inflation.

Inflated and ready for use, the boat measures 8½ feet. It is constructed of neoprene-coated nylon fabric to give long shelf life, and a special coating gives extra protection against ozone action. The floor is also inflatable, providing unusual stability, rigidity, and insulation against cold water. This boat is available in a color choice of international orange, sea green, or olive drab.

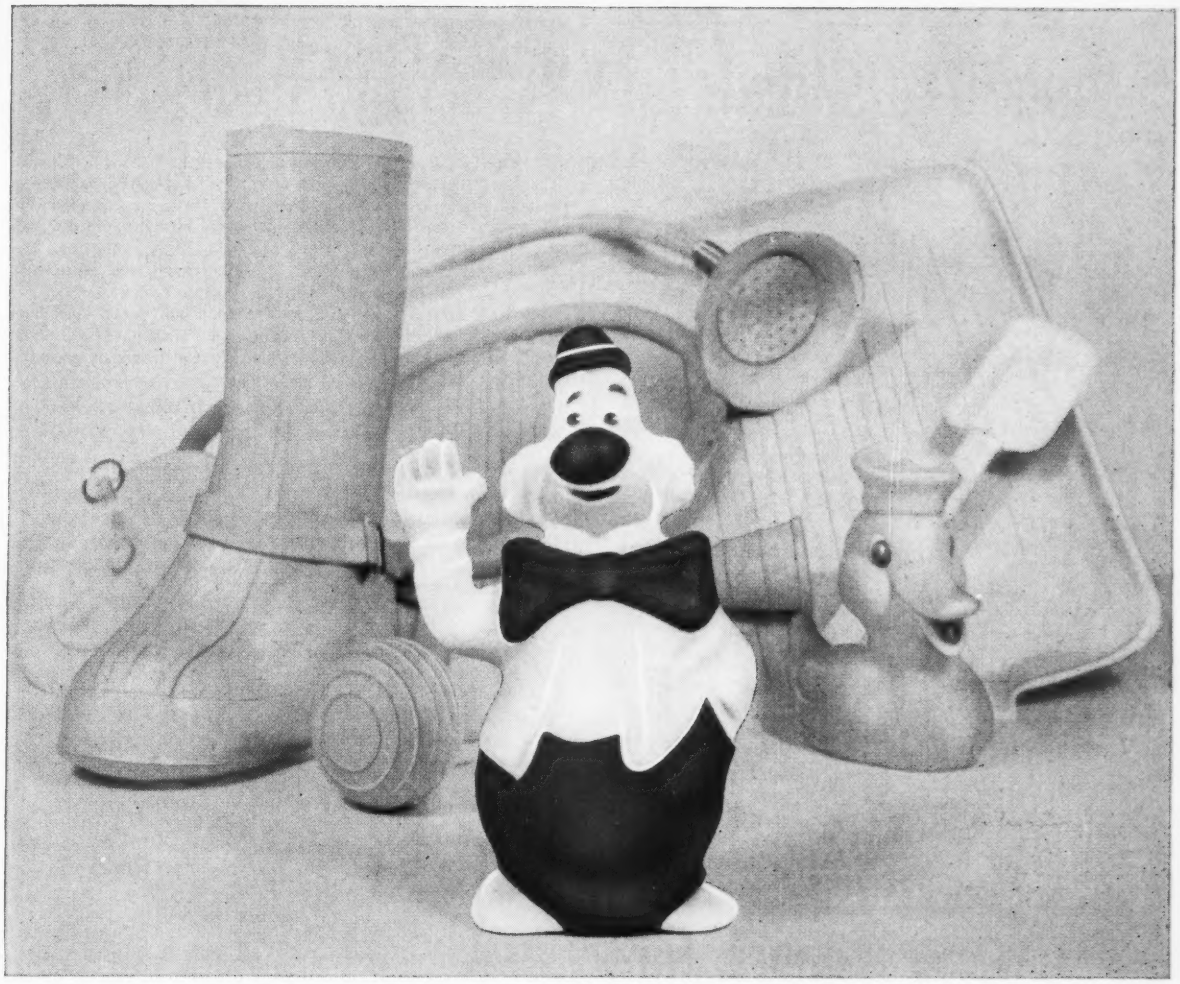
The dinghy's carrying case is 35 inches long and has a circumference of 14 inches, making it easy to fit into the trunk of a car or find storage space on a boat. The whole unit weighs less than 42 pounds. With its paddles and hand-pump, the dinghy will sell for $198.50.

Imperial Fire Hose

A new industrial fire hose made with an all-Dacron jacket has been announced by B. F. Goodrich Industrial Products Co., Akron, O. The hose can withstand extended service in mud holes, underground mines, or acidic atmospheres. Designated the Imperial hose, it was originally designed for heavy-duty service in oil refineries and chemical plants. The hose is now recommended for fire service in the contracting and mining industry, in general industrial plants, and aboard ships for washdown service.

The single-jacket hose is designed to withstand surge pressures far beyond its initial 500-psi. pressure test. The hose, it is further claimed, has exceptional resistance to abrasion as well as being impervious to mildew, oil, acids, alcohols, hydrocarbons, and detergents. The Dacron jacket, woven by an exclusive BFG process, makes Imperial hose lighter, more flexible, stronger, and longer-wearing than conventional industrial fire hose. Uniform tension on each strand during the weaving process keeps pressures equally distributed when hose is in use, strengthens the hose

(Continued on page 202)



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- NCP 1909. An anti-tack coating. Spray or brush it on any tacky surface where powder is normally used to kill tack before cure.
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- SPECIAL lacquers for all types of rubber products.

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New Products

(Continued from page 200)

throughout its length, according to Goodrich.

Ends of the new hose are reinforced with BFG's patented Plylock end protection, a layer of hard twisted cords extending 12 inches back from the coupling. Strong, tough, oilproof rubber made for hose tube permits use of a thinner tube than that used in conventional fire hose, thus increasing the amount of water delivery without increasing the outside diameter.

Imperial hose is available in the following sizes: one inch, 1½ inches, two inches, 2½ inches. A bulletin, 3740, giving specifications for Imperial and other similar hoses, is available from the company.

Firestone Tractor Tire

A new, low-price farm tractor tire, called the Champion Ground Grip, is being offered by The Firestone Tire & Rubber Co., Akron, O. Priced at approximately 20% less than original-equipment tires, it is a rear replacement tire.

New shoulder treatment and special cord body are the main features of the tire. More rubber has been added to the critical shoulder and bar-end area to guard against cracking. The connected shoulder design allows a thicker, more even distribution of rubber in that area, according to Firestone.

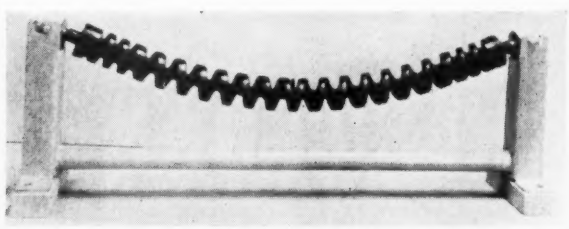
Cord used in the body of the tire is fortified against field shock by a special heat treating and dipping process. The rayon fabric is stretched under controlled heat and dipped into liquid rubber.

The sidewall of the Champion Ground Grip is protected against aging and cracking by a specially compounded rubber. The sidewall rubber has been made tougher to give necessary resistance to weather cracking. A special tread compound, Rubber-X, is used in the new tire.

Spiral-Shaped Idler

A new spiral-shaped rubber idler for belt conveyors has been developed by Hewitt-Robins, Inc., Stamford, Conn., to handle coal, ores, fertilizers, chemicals, coke, aggregates, cement, and other bulk materials. The idler, highly flexible and adaptable to any type of belt conveyor, is made of tough synthetic rubber molded around a wire rope. Although smaller in diameter and lighter in weight than conventional all-metal idlers, it carries the conveyor belts which ride over it smoothly and efficiently under either heavy or light loads.

The double corkscrew-shape design of the idler is said to have these advantages: self-cleaning action produced by constant flexing from end-to-end; flexibility enabling it to conform to variation in belt load; mounting brackets on ends of the idler permitting free pivot in the vertical plane; and easy replacement simply by lifting out worn idlers and dropping in new ones. Also, intrusion of dirt into moving parts is prevented by newly developed seals. The torsional strength resulting from the continuous rubber spiral is said to insure long life and to reduce internal twisting. The idlers will be available for belt widths of 18, 24, 30, and 36 inches.



Hewitt-Robins spiral-shaped idler

Gives high whiteness—with minimum loading

UNITANE® 0-220

TITANIUM DIOXIDE

Save – through minimum loading – with UNITANE 0-220, yet get maximum whiteness in the bargain! The high opacity and clear color tone of this pigment give it maximum whitening power; you load less, get better results!

UNITANE 0-220 also eliminates some of the trouble spots in processing. It wets easily, is readily dispersible and is non-reactive with rubber chemicals. UNITANE 0-220 maintains its brilliancy throughout curing and aging, assuring a better-looking finished product with longer-lasting whiteness.

For economy, easier processing and product improvement, specify UNITANE 0-220. Just ask your Cyanamid Pigments representative for samples and full information.

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Plasticizer Data
TO HELP YOU CHOOSE THE RIGHT PLASTICIZER

these Harflex® Plasticizers are non-toxic

Dibutyl Sebacate

FDA Accepted • Odorless • Tasteless • Excellent Low Temperature Characteristics

Appearance	Clear liquid
Color, APHA	25 max.
Odor	Neutral
Specific Gravity, 20/20°C	0.936 ± 0.003
Free acidity, as acetic acid	0.01% max.
Ester Content	99.0% min.

Other Uses—
Vinyl chloride resins, copolymers and plastisols, safety glass and safety plastic interlayers, cellulose acetobutyrate, neoprene and acrylonitrile-butadiene copolymer low temperature formulations, rubber hydrochloride films.

Dicapryl Phthalate

FDA Accepted for foods of high water content only

Appearance	Clear liquid
Color, APHA	50 max.
Odor	Faint
Specific Gravity, 20/20°C	0.972 ± 0.003
Free acidity, as acetic acid	0.01% max.
Ester content	99.0% min.

Other Uses—
Vinyl chloride resins, copolymers and plastisols, nitrocellulose, ethylcellulose, acrylates, natural and synthetic rubbers and polyvinyl butyral.

HARCHEM produces a full line of sebacate, phthalate, adipate and polymeric plasticizers in addition to the Food and Drug Administration accepted plasticizers shown.

The Harchem Division laboratories will gladly assist you with your plasticizer problems, or will supply additional data including formulation test results and formulation suggestions for any Harflex Plasticizer.

Address inquiries to Dept. H-38R

SEBACATES
PHTHALATES
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Columbian Carbon Company, Distributor To The Rubber Industry

HARCHEM DIVISION

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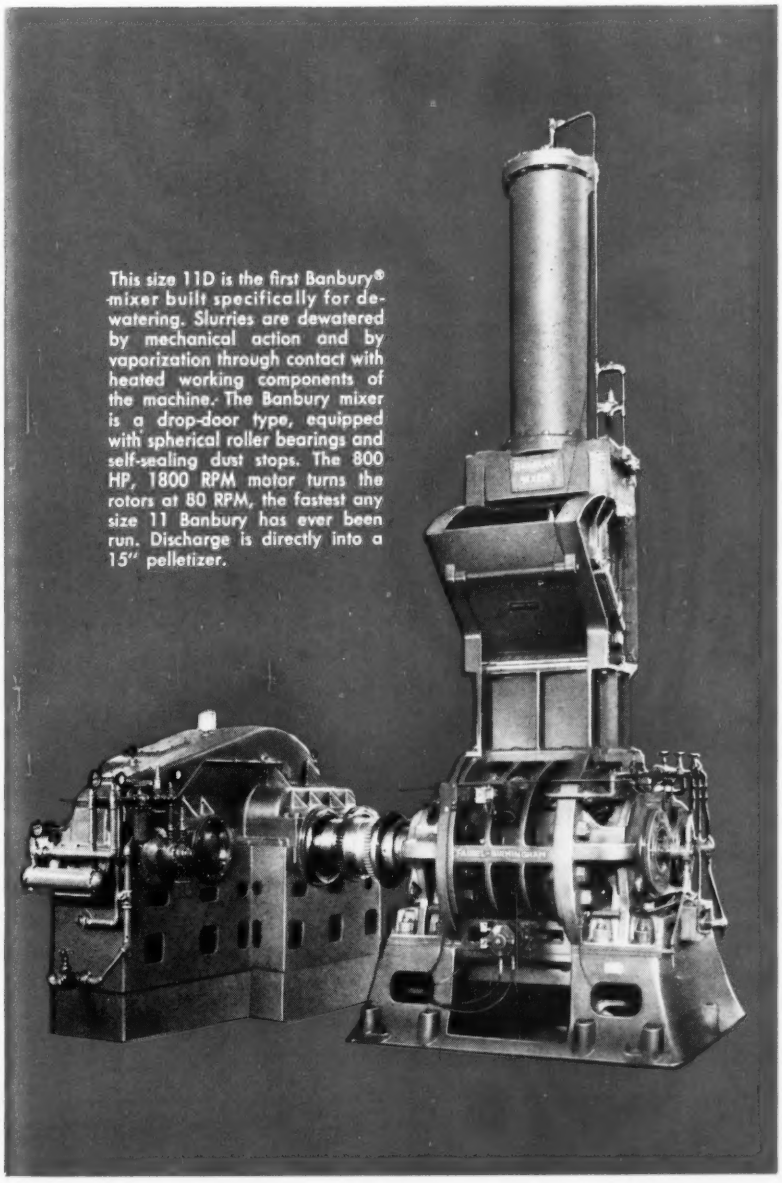
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY
IN CANADA: W C HARDESTY CO. OF CANADA, LTD., TORONTO

NEW BANBURY® FOR DEWATERING

designed to produce 6000 pounds of dry rubber per hour



This size 11D is the first Banbury® mixer built specifically for dewatering. Slurries are dewatered by mechanical action and by vaporization through contact with heated working components of the machine. The Banbury mixer is a drop-door type, equipped with spherical roller bearings and self-sealing dust stops. The 800 HP, 1800 RPM motor turns the rotors at 80 RPM, the fastest any size 11 Banbury has ever been run. Discharge is directly into a 15" pelletizer.

Now...another Farrel first: The dewatering of synthetic rubber slurries by Banbury® mixer. According to tests conducted at the company's process laboratory, this size 11D Banbury mixer will produce 400 pounds of dry rubber in 4-minute cycles. This means an hourly output in the neighborhood of 6000 pounds.

In addition to high production rate, dewatering by this method offers other important advantages. When changing stocks, costly cleaning operations are not required. Normal wear of parts will not seriously affect production. Also, the equipment can be used for other purposes, such as making carbon black masterbatches, the carbon black being added as a slurry during the dewatering cycle, or as a dry powder afterward.

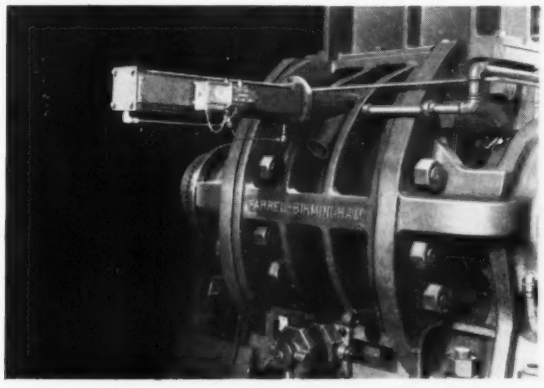
Ask for further details of dewatering by Banbury mixer.

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONNECTICUT

Plants: Ansonia & Derby, Conn., Buffalo & Rochester, N. Y.
Sales Offices: Ansonia, Buffalo, Akron, Chicago, Ann Arbor (Mich.), Los Angeles, Houston, Fayetteville (N. C.)
European Office: Piazza della Republica 32, Milano, Italy

FB-1165

FARREL®



The dewatering valve, which can be seen in the illustration at the right, opens when floating weight reaches down position. Water, which has been squeezed from the slurry, is then drained or pumped out.

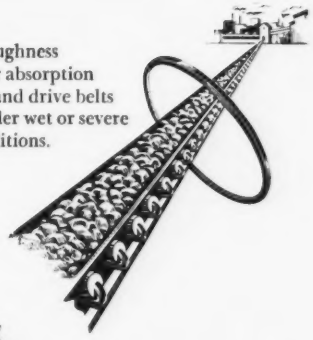
SYNPOL
Ultra-Dispersed
Carbon Black
Masterbatch
PROVED
BY OVER
50 MILLION LBS.

Can your products benefit from these proven-in-use properties?

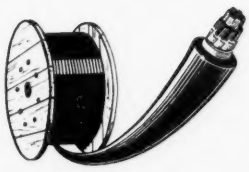
New toughness and abrasion resistance for tire sidewalls, carcasses and tread. Less flex-cracking and cut growth. Reduced mixing times and increased reinforcing effect of carbon black due to greatly improved initial dispersion.

Low water absorption for boots and waders. Ultra-Dispersed Black for long-wearing, non-marking heels and soles.

Camelback service life surpassing that of new tire treads produced from conventional masterbatches. Uniformity in processing and curing—plus profit factors to processor *and* recapper.



Maximum toughness and low water absorption for conveyor and drive belts operating under wet or severe abrasion conditions.



Smoother and faster-running extrusions. Premium qualities of low water absorption and good insulating properties at standard cost for electrical insulation jacket stocks and tapes.

Shorter mix cycles, cleaner operations and resistance to cutting, chipping or flex-cracking for molded products such as industrial rolls and mountings.

Try this thoroughly commercially proved product in your own formulations Enjoy all the product and processing advantages SYNPOL Black Masterbatch offers. For more information . . . for any quantity from a sample to a carload . . . call your TEXUS Representative today.

SYNPOL Ultra-Dispersed BLACK MASTERBATCHES NOW AVAILABLE

	Black	Oil	Emulsifier
SYNPOL 8150	50 pts. HAF	None	Rosin Acid
SYNPOL 8250	50 pts. HAF	25 pts. Highly Aromatic	Mixed Soap
SYNPOL 8253	60 pts. FEF	37.5 Naphthenic	Rosin Acid
SYNPOL 8254	75 pts. HAF	37.5 pts. Highly Aromatic	Mixed Soap
SYNPOL 8266	75 pts. ISAF	37.5 pts. Highly Aromatic	Rosin Acid

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CUTS COST WITHOUT CUTTING QUALITY

CAR-BEL-REZ C
T. M.

IN SBR, NEOPRENE AND NBR RUBBER

SBR

When compounded in equal parts with SBR, Car-Bel-Rez C yields vulcanizates of improved oil and ozone resistance with excellent physical properties and processing. The resin is an excellent reinforcing agent in non-black stocks. Car-Bel-Rez C is believed to be co-vulcanized with the SBR through the chemically combined sulphur in the resin, which is also responsible for its oil resistance. The "free sulphur" (polysulphide) content materially reduces the sulphur or accelerators needed in the recipe. SBR vulcanizates containing Car-Bel-Rez C can be made to meet the basic requirements for oil-resistant rubber, type S, Class SC.

NBR RUBBER

Used as an extender in NBR copolymer, Car-Bel-Rez C does not appreciably lower oil resistance and excellent physical properties can be obtained.

NEOPRENE

When up to 20 parts of Car-Bel-Rez C are added to neoprene stocks, they maintain neoprene's oil resistance without materially changing physical properties. However, the resin reduces stickiness, improves bin aging, plasticizes the stock and gives good flex life. When 50 parts are added, superior ozone resistance is obtained.

CAR-BEL-REZ C disperses easily without high-temperature mixing.

CAR-BEL-REZ C IS MADE BY THE CARTER BELL MFG. CO.
FOR COMPLETE TECHNICAL AND APPLICATION DATA WRITE TO:

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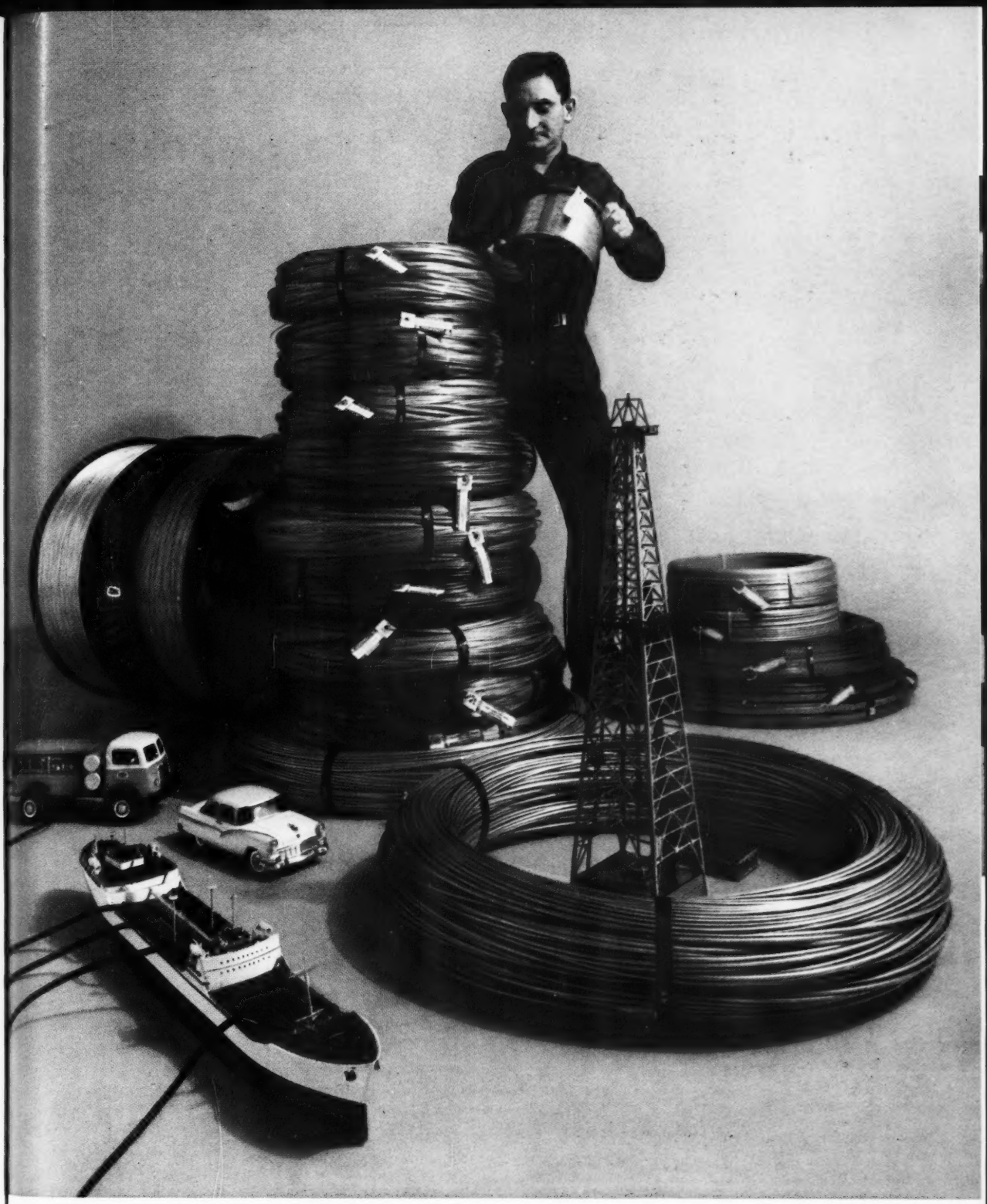

Strong Restraining Influences...

Roebling Hose Reinforcing Wire

Roebling Hose Wire, Hose Reinforcing Wire and Hose Wrapping Wire bear the stamp of Roebling's strict attention to constant uniformity. As with all Roebling wire products, each is wholly Roebling-made and Roebling-controlled, from open hearth to packaging. Tensile strength and forming qualities, finish and gage are of an excellence that proves itself in use.

Resistance to internal and external pressures and wear are what you look for in hose wires and what you pay for. With Roebling, you *get* them.

For further information on these and other Roebling quality products, write Wire and Cold Rolled Steel Products Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

Roebling...Your Product is Better for it

ROEBLING

Branch Offices in Principal Cities
Subsidiary of The Colorado Fuel and Iron Corporation

*MILLEX

PROPERTIES:

Physical Form	Friable solid
Color	Brown
Specific Gravity	1.01
Melting Point	250 F. (Approx.)
Odor	Slight Asphaltic

LOW COST—LOW GRAVITY

COMPOUNDING INGREDIENT

for RUBBER & RUBBER-LIKE MATERIALS.....

MILLEX is a selected Gilsonite-base product, specially compounded to render it readily miscible with rubber and rubber-like materials.

MILLEX is recommended for use in wire insulation, tapes, soles and heels, boots and shoes, and extruded goods, cured in air or open stem. It is also recommended as a low cost, low gravity extender for semi-rigid vinyl resin compounds.

COMPOUNDING CHARACTERISTICS:

In GR-S, natural or reclaimed rubber, MILLEX improves processing and flattens stocks without undue softening before, during and after cure. This ensures clean embossing, smooth tubing and calendering. MILLEX enhances freedom from flow and sagging in open steam cures, and provides good mill release and freedom from tackiness (as in high reclaim stocks). Cured stocks show good hardness and modulus, plus an extremely smooth finish. Low capacity, low power factor and high insulation resistance, coupled with low moisture absorption ensures excellent electrical behaviour.

MILLEX is compatible with vinyl resins; lends itself to semi-rigid uses such as low-cost records, chemical resistant conduits, dark flooring and paneling, etc.

While dark brown in color, MILLEX has relatively low hiding power—lends itself for use in light brown or tan-colored compositions (soles and heels for combat or service-type shoes and boots).

SOME TYPICAL APPLICATIONS:

- Wire Insulation
- Tape
- Molded Goods
- Floor Mats (auto)
- Conduits (chemical resistant)
- Records (low cost)
- Flooring (dark)
- Paneling (dark)
- Soles & Heels (combat-service-type boots & shoes)
- Weather Stripping
- Channeling

FOR BEST RESULTS—MILLEX SHOULD BE ADDED DIRECTLY TO GR-S DURING BREAKDOWN PERIOD.

Write for Literature and Working Samples!

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CARY CHEMICALS INC.

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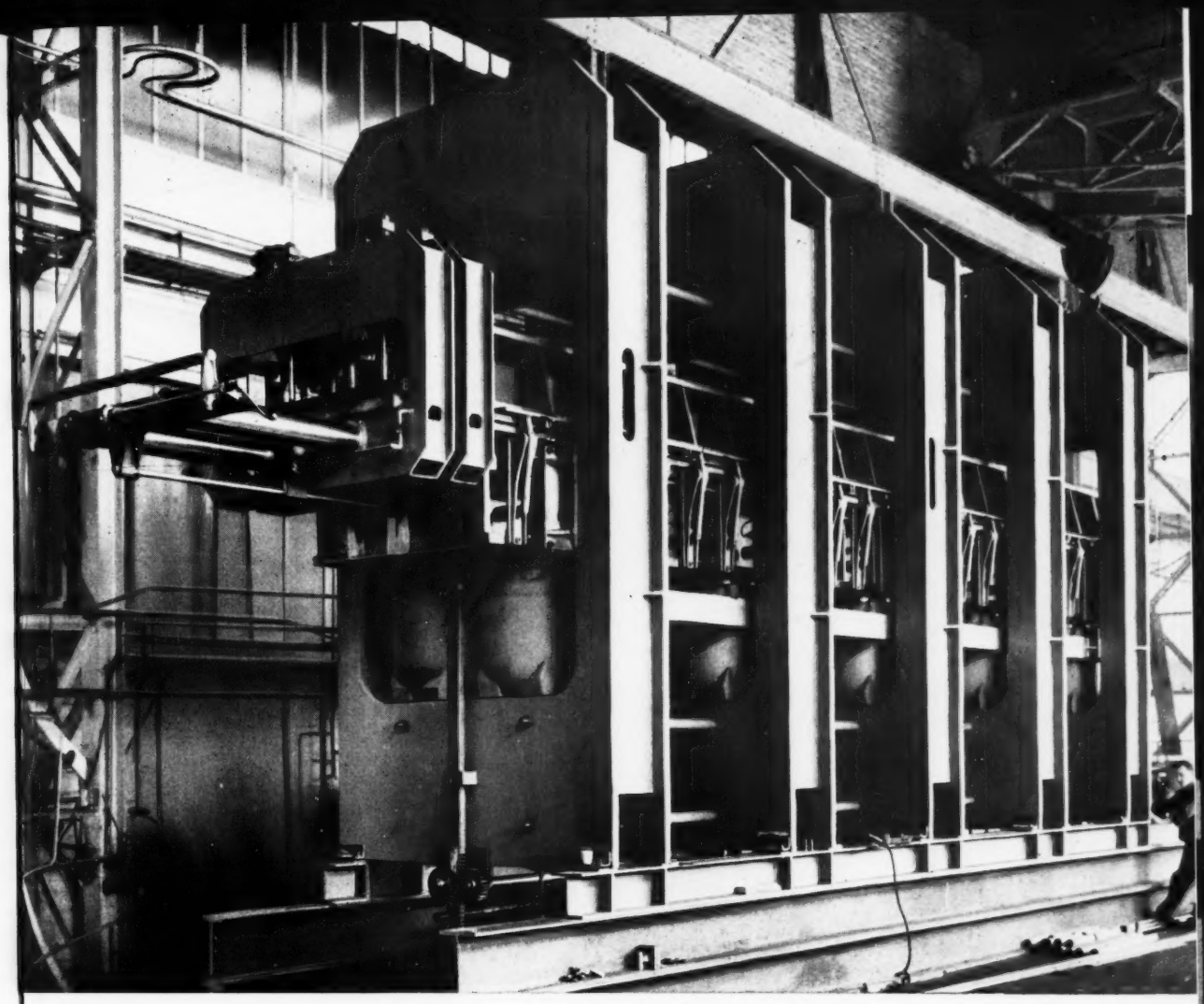
Mail address: **P.O. BOX 1128, NEW BRUNSWICK, N. J.**

Plants at: East Brunswick and Flemington, N. J.

VINYL RESINS — VINYL COPOLYMERS — VINYL COMPOUNDS — SPECIALTY WAXES — HIGH MELTING POINT SYNTHETIC WAXES

Canadian Representative: Lewis Specialties, Ltd., 18 Westminster North, Montreal 28, Que.



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We supply belting presses with a working width up to 10 feet.

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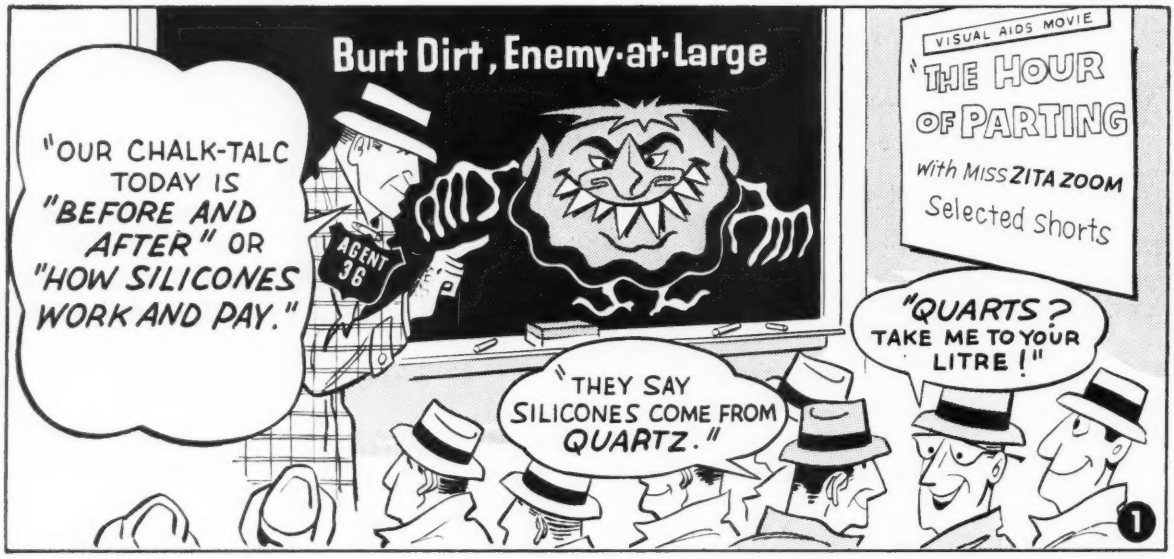
AGENT 36
SILICONE SQUAD

HOW I TRAIN ADVICE SQUADS

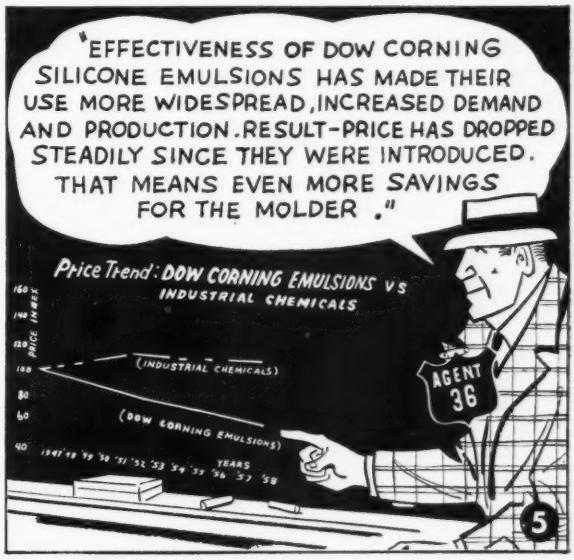
FROM THE OFFICIAL FILES OF DOW CORNING


Burt Dirt, Enemy-at-Large
"OUR CHALK-TALC TODAY IS "BEFORE AND AFTER" OR "HOW SILICONES WORK AND PAY."
AGENT 36
VISUAL AIDS MOVIE
"THE HOUR OF PARTING
with Miss ZITA ZOOM
Selected Shorts
"THEY SAY SILICONES COME FROM QUARTZ."
"QUARTS? TAKE ME TO YOUR LITRE!"
1

TIPTOE THRU THE TALCUM
JOE STORMIN Foreman
"IN THIS PLANT YOU SEE MESS, WASTE MAINTENANCE, AND... WORST OF ALL.. MOLD DOWNTIME. THAT'S BECAUSE THEY DON'T USE SILICONES FOR MOLD RELEASE."
AGENT 36
"IT'S DIRT!"
"IT'S A BOG!"
"IT'S A DIRT BOG!"
2

"HERE'S A PLANT THAT USES SILICONE PARTING AGENTS. NOTE THAT THERE'S NO BUILD-UP IN MOLDS, THEREFORE, VIRTUALLY NO MOLD CLEANING. MOLD DOWNTIME IS CUT TO NIL. SCRAP GOES DOWN. BETTER PRODUCTS RESULT. MONEY IS SAVED! VERY LITTLE TALC IS USED, THE PLANT STAYS CLEANER-SO EVERYONE'S HAPPIER!"
FOREMAN
DOW CORNING 36
SMACK
CURSES!
AGENT 36
"SILICONES ARE BREAKING UP THAT MOLD GANG OF GRIME."
"THIS PLACE IS PEACHY CLEAN, GENE!"
3

"YOU'VE SEEN DIRT CLOG A PLANT'S PRODUCTION, AND HOW SILICONE RELEASE AGENTS ELIMINATE THE MESS. BACK IN CLASS, I'LL SHOW YOU MORE FACTS..."
Rubberneck '36'
4


"EFFECTIVENESS OF DOW CORNING SILICONE EMULSIONS HAS MADE THEIR USE MORE WIDESPREAD, INCREASED DEMAND AND PRODUCTION. RESULT-PRICE HAS DROPPED STEADILY SINCE THEY WERE INTRODUCED. THAT MEANS EVEN MORE SAVINGS FOR THE MOLDER."
Price Trend: DOW CORNING EMULSIONS VS INDUSTRIAL CHEMICALS
PRICE INDEX
160
140
120
100
80
60
40
(INDUSTRIAL CHEMICALS)
(DOW CORNING EMULSIONS)
1947 '48 '49 '50 '51 '52 '53 '54 '55 '56 '57 '58
YEARS
AGENT 36
5

"NOW A WORD FROM A SLICK OPERATOR, SERGEANT SYL-OFF."
"ALWAYS REMEMBER - SYL-OFF IS THE PERFECT RELEASE COATING FOR BAGS OR UNIT CONTAINERS. NOTHING STICKS TO A SYL-OFF PAPER COATING. THAT'S WHY P.A.'S SPECIFY CONTAINERS COATED WITH SYL-OFF FOR CRUDE AND OTHER STICKERS."
AGENT 36
6

first in silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS
LOS ANGELES NEW YORK WASHINGTON, D. C.

EAGLE-PICHER
Lead & Zinc Compounds
meet the specific demands of the rubber industry . . .

Eagle-Picher manufactures a comprehensive line of both lead and zinc compounds for the rubber industry. Rigid product control is maintained from the ore to the finished product. More than a century of experience assures you of customer service unequalled in the field.

Zinc Oxides	Litharge
Basic White Lead Silicate	Sublimed Litharge
Basic Carbonate of White Lead	Red Lead (95% 97% 98%)
Sublimed White Lead	Sublimed Blue Lead

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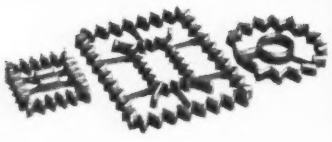
EXPERIENCE... WE HAVE OVER 50 YEARS OF IT...

INDEPENDENT AND NEW ERA

Dies For Every Conceivable Purpose



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DISTRIBUTORS FOR:
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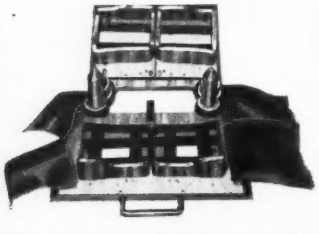
- Hard Maple, Rubber, and Fibre Composition Die Blocks
- Rubber Pads
- Die Block Hardener
- Raw Hide Mauls



INDEPENDENT DIE & SUPPLY CO.
LA SALLE & OHIO STS. . . . ST. LOUIS 4, MISSOURI
Associate: NEW ERA DIE CO. Red Lion, York County, Pa.

NEW MATERIALS

New Flexzone 3-C

A new all-purpose antioxidant-antiozonant, designated Flexzone 3-C, is now available as an easy-to-disperse flaked, relatively non-migratory material from the Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn. Its composition is N-isopropyl-N'-phenyl-p-phenylene diamine and heat aging tests show that it is relatively non-volatile. It is reported to be especially effective in natural and styrene-butadiene rubbers and blends of these elastomers, but is not recommended for use in products where discoloration and staining are factors.

Actual commercial tests in tires, mechanical goods, footwear, insulated wire, and other rubber products show that Flexzone 3-C produces a significantly higher level of protection against flex cracking and ozone attack than any other commercial chemical, according to Naugatuck. This material produces exceptional resistance in rubber products to the deteriorating action of heat and oxygen also and, in addition, is an anti-copper agent. It is not adversely sensitive to other compounding ingredients as are certain other phenylene diamine antiozonants.

Some typical physical properties of Flexzone 3-C follow:

Form	purple-gray flakes
Specific gravity	1.14
Melting point	70° C. minimum
Protective value against:	
Heat	excellent
Oxygen	excellent
Flexing fatigue	excellent, considered a super flex-cracking inhibitor.
Copper deterioration	excellent
Storage stability	good
Solubility	soluble in benzol, ethylene dichloride, gasoline, ethyl acetate; insoluble in water

A technical bulletin, Compounding Research Report No. 43, which gives recommended amounts to use, compounding properties, and test methods and results for Flexzone 3-C in truck-tire treads and in passenger-car tires, is available from the company.

New Release Parchment

A new releasing parchment, designated Number 40-91T, for industrial applications where color and smoothness of the vegetable parchment are not critical factors, has been introduced by the Paterson Parchment Paper Co., Bristol, Pa. Recommended uses for it include an all-purpose release backing for any type of tacky material, interleaver for rolls and slabs of raw rubber, release backing for pressure felts, tapes, and gaskets, separator strips for rubber tapes, casting sheet for organic adhesives, films, and organosols, and casting sheet for chemical foams.

Possessing moderate weight and rigidity, excellent release, high strength, and resistance to wetting and staining, Parchment 40-91T also is reported to have the following characteristics: smooth fiber-free surface; fair flexibility; good water shedding and resistance to oil and plasticizers penetration; brown color; elongation-machine direction 1.3%, and cross direction 5.5%; approximate tensile strength—32 pounds per inch machine direction, and 23 pounds per inch cross direction; size—rolls

(Continued on page 218)

Another new development using

B.F.Goodrich Chemical *raw materials*

These tool handles are molded in various colors by Fawick Flexi-Grip Company, Akron, Ohio. B.F.Goodrich Chemical Company supplies the Hycar nitrile rubber.

Handles of Hycar help tool users come to grips with grease problems

These colorful tool grips are molded especially for use in gas stations, machine shops and maintenance areas. Unlike handles molded with conventional rubber, they won't get soft and sticky in shop use. Hycar nitrile rubber resists oil, gas, chemicals and solvents.

Hycar wears and wears because of its toughness and unusual abrasion resistance. It's no wonder that since they've started equipping tools with handles of Hycar, tool makers are experiencing measurable increases in sales.

Hycar nitrile rubber has wide application wherever gas, oil or chemicals may be a problem—or wherever you need extra abrasion resistance, strength or flexibility. There are many different types of Hycar rubber available—in latex form as well as dry rubber. For more information, write Dept. CB-3, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

Hycar
Rubber and Latex

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

B.F.Goodrich

GEON polyvinyl materials • HYCAR rubber and latex
GOOD-RITE chemicals and plasticizers • HARMON colors

News about

B.F.Goodrich Chemical *raw materials*

NEW, EASIER PROCESSING POLYMER HYCAR 1051

offers fabrication advantages with significant physical improvements

Hycar 1051 is the high acrylonitrile polymer of a new series of three polymers that are a major improvement in nitrile rubber. All three produce superior end products. The other two, announced previously, are Hycar 1052, medium high acrylonitrile, and Hycar 1053, medium acrylonitrile.

These three polymers combine a range of oil and solvent resistance superior to other nitrile rubbers, providing improved tensile with higher elongation and lower moduli. Users are enthusiastic. They report reductions in mixing time and lower power requirements on mixing equipment. They also report better mold flow that reduces rejects, and better building tack for making rolls, tank linings, and similar products.

Samples of Hycar 1051, or the other two Hycar polymers in this series, are available with further information. To get them write Dept. CB-3, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

Hycar
Reg. U. S. Pat. Office
Rubber and Latex

B.F.Goodrich Chemical Company
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GEON polyvinyl materials • HYCAR rubber and latex
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Another new development using

B.F.Goodrich Chemical *raw materials*

These tool handles are molded in various colors by Fawick Flexi-Grip Company, Akron, Ohio. B.F.Goodrich Chemical Company supplies the Hycar nitrile rubber.

Handles of Hycar help tool users come to grips with grease problems

These colorful tool grips are molded especially for use in gas stations, machine shops and maintenance areas. Unlike handles molded with conventional rubber, they won't get soft and sticky in shop use. Hycar nitrile rubber resists oil, gas, chemicals and solvents.

Hycar wears and wears because of its toughness and unusual abrasion resistance. It's no wonder that since they've started equipping tools with handles of Hycar, tool makers are experiencing measurable increases in sales.

Hycar nitrile rubber has wide application wherever gas, oil or chemicals may be a problem—or wherever you need extra abrasion resistance, strength or flexibility. There are many different types of Hycar rubber available—in latex form as well as dry rubber. For more information, write Dept. CB-3, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

Hycar
Rubber and Latex

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

B.F.Goodrich

GEON polyvinyl materials • HYCAR rubber and latex
GOOD-RITE chemicals and plasticizers • HARMON colors

News about

B.F.Goodrich Chemical *raw materials*

NEW, EASIER PROCESSING POLYMER HYCAR 1051

offers fabrication advantages with significant physical improvements

Hycar 1051 is the high acrylonitrile polymer of a new series of three polymers that are a major improvement in nitrile rubber. All three produce superior end products. The other two, announced previously, are Hycar 1052, medium high acrylonitrile, and Hycar 1053, medium acrylonitrile.

These three polymers combine a range of oil and solvent resistance superior to other nitrile rubbers, providing improved tensile with higher elongation and lower moduli. Users are enthusiastic. They report reductions in mixing time and lower power requirements on mixing equipment. They also report better mold flow that reduces rejects, and better building tack for making rolls, tank linings, and similar products.

Samples of Hycar 1051, or the other two Hycar polymers in this series, are available with further information. To get them write Dept. CB-3, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

Hycar
Reg. U. S. Pat. Office
Rubber and Latex

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

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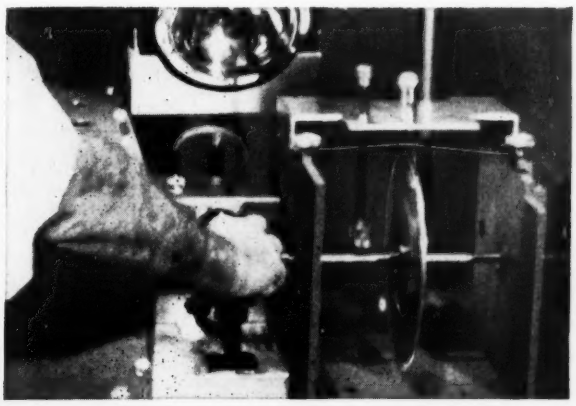
MORE TIRE POWER means MORE IMPACT RESISTANCE

Tires made with TYREX viscose tire cord sustain up to 60% fewer bruise breaks



1. ***PROVED IN THE LABORATORY . . .*** Although nylon cord stands up well under slow steady strains, sensitive instruments such as this show that its performance *decreases* as strains become more abrupt. TYREX viscose cord, however, becomes *stronger*.

2. ***NOW PROVED IN ROAD TESTS!*** To prove it, nylon cord tires and tires made with TYREX viscose tire cord were driven up to 45 MPH along one of Nevada's toughest roads . . . with rock outcroppings painted brightly so they couldn't be missed.

3. ***SOME CORDS WEAKEN IN HIGH-SPEED IMPACTS...*** The constant hammering proved too much for the nylon cord tires. One by one the casings failed . . . an average of one bruise break every 620 miles—proving that nylon *does* become more brittle at high speeds.

4. ***TYREX VISCOSE TIRE CORD GETS TOUGHER!*** But the tires made with TYREX viscose tire cord averaged more than three times as many miles-per-impact-break . . . and throughout the test sustained *60% fewer impact breaks than tires containing nylon cord!*

Get more tire power into your tires. Specify TYREX viscose tire cord—the tough new cord that makes any tire run cooler, softer, quieter and safer . . . without flat spotting.

TYREX*

TYREX INC., EMPIRE STATE BLDG., NEW YORK 1, N. Y.

**TYREX is a certification mark of Tyrex Inc., for viscose tire cord and yarn. TYREX viscose tire cord and yarn is also produced and available in Canada.*

RC
for low temperature Elastomers
PLASTICIZERS

* RC Plasticizer TG-8 (Triethylene Glycol Dicaprylate)
* RC Plasticizer TG-85 (Triethylene Glycol Caprate-Caprylate)
* RC Plasticizer TG-9 (Triethylene Glycol Dipelargonate)
* RC Plasticizer DOA (Dioctly Adipate)
* RC Plasticizer DOS (Dioctly Sebacate)
* RC Plasticizer DBP (Dibutyl Phthalate)
* RC Butyl Oleate

For use in GR-S, Neoprene, Buna N and natural rubber compounds to reduce nerve and produce superior flex and smooth extrusions. Write for samples!

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Toughens
RUBBER
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Of all the muscle-building ingredients used by plastics formulators and rubber compounders to develop specification - toughness, Claremont Cotton Fillers have proven the most satisfactory. Many, many millions of pounds of Claremont Fillers have already shared in making many more millions of plastic parts and rubber products functionally strong.
Available in several classification-grades from fine flock to macerated fabric pieces. Strict quality manufacturing controls assure uniformity.
CLAREMONT FLOCK CORPORATION
Write for Samples
The Country's Largest Manufacturer of FLOCK
CLAREMONT, NEW HAMPSHIRE

New Materials

(Continued from page 214)

and sheet 60 inches wide, wider sizes available on special orders; approximately 8.3 square yards per pound; caliper—approximately 0.0033-inch; basic weight—500 sheets 24 by 36 inches weigh 40 pounds; other weights available on request.

New Fluorel Elastomer

A new highly fluorinated synthetic elastomer, designated Fluorel, has been announced by the chemical division, Minnesota Mining & Mfg. Co., St. Paul, Minn. Much experimental work on this material was done under the sponsorship of the Quartermaster Corps of the Department of Defense and was reported at the Fifth Joint Army-Navy-Air Force Conference on Elastomers, October 15-17, 1958, Dayton, O. This basic research work on this new material has been abstracted from a paper, "Quartermaster Corps Sponsored Fluoroelastomer Research at 3M," by G. H. Crawford and J. C. Montermoso, and appears in RUBBER WORLD, December, 1958, page 408.

Designed for use at +400° F. with a wide variety of corrosive chemicals, synthetic fuels, and functional fluids, Fluorel elastomers are expected to find broad applications in the fuel and hydraulic systems of aircraft and missiles, and in seals and liners in the automotive and chemical industries. In addition to its thermal stability at high temperatures, the elastomer chemically resists such fluids as diester, silicate ester, or petroleum-based lubricants and hydraulic fluids, JP-type aromatic fuels, HEF or Hi Cal fuels, and powerful oxidants such as 90% hydrogen peroxide and red fuming nitric acid.

Some of its reported properties include low-compression set, good ozone resistance, good electrical properties, and non-combustibility. Fluorel can be compounded to meet USAF specification MIL-R-25987 for high-temperature, fluid-resistant elastomeric compounds.

In its raw gum state, it has been designed for ease in processing, using standard rubber-compounding and fabricating equipment. The elastomer must be vulcanized for optimum mechanical properties and thermal stability. Most practical vulcanizates are those compounded with a blocked polyamine curative available from 3M, along with various metallic oxide acid acceptors. Stocks have been both compression molded and extruded.

For cement coatings, the elastomer is soluble in selected ketones and esters. Aliphatic and aromatic hydrocarbons and alcohols are satisfactory diluents. Also, reports 3M, the elastomer can be bonded to most metals with a silicone-based adhesive. Fluorel is available in one-, five-, and ten-pound units.

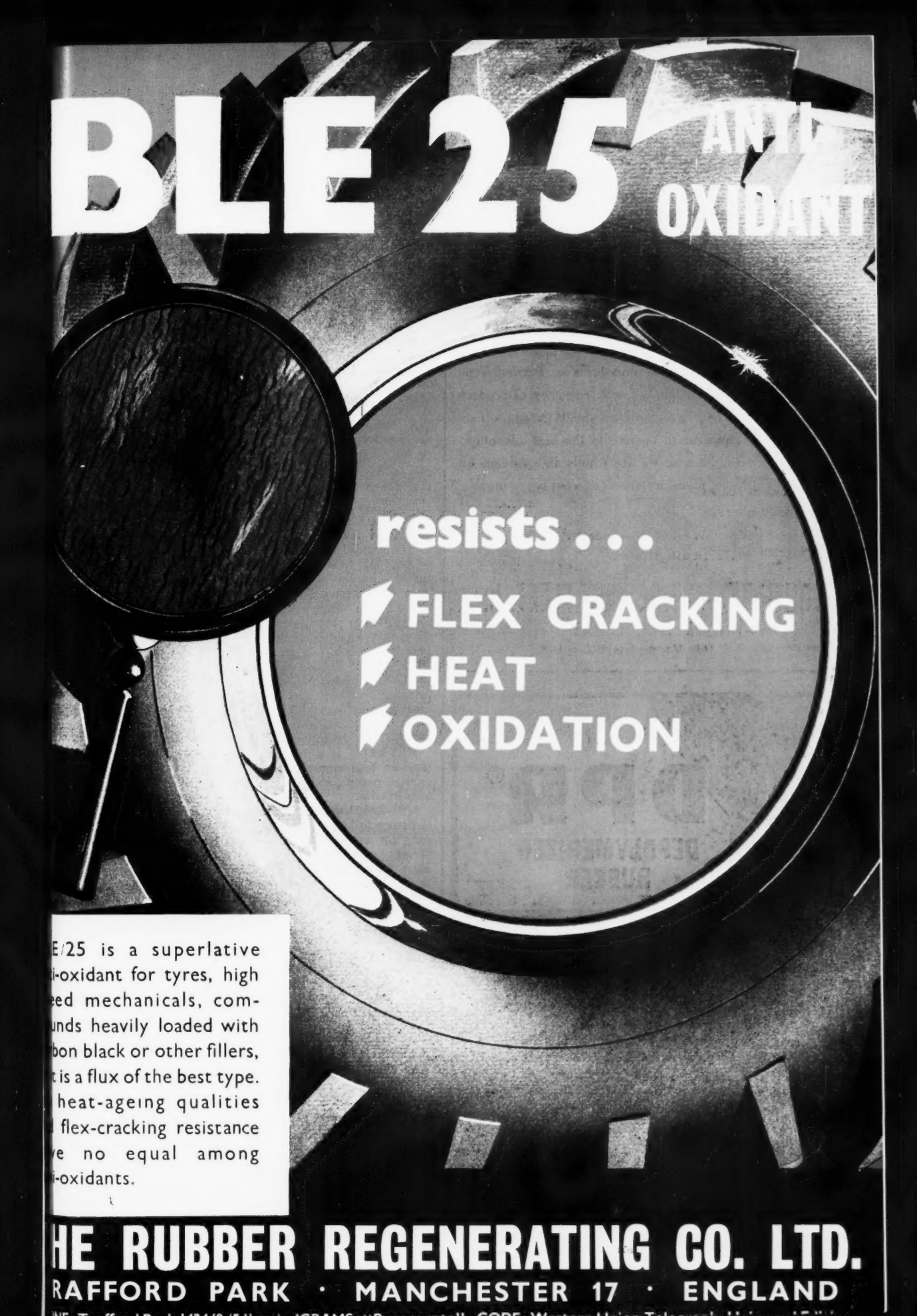
Plastolein Epoxy 9213, 9214, 9232

Three new Plastolein epoxy plasticizers are available from Emery Industries, Inc., Cincinnati, O. Plastolein 9213 and Plastolein 9214 are epoxy plasticizers (and/or stabilizers) of the monomeric type for vinyls. Plastolein 9232 is a high molecular weight epoxy-type plasticizer which can be used as a heat and light stabilizer for vinyls or as a secondary plasticizer that contributes permanence.

Plastolein 9213 is suggested as a low-temperature secondary plasticizer. As increments of it are added to DOP in the plasticizer system, the low-temperature exposure performance and heat stability are improved. This material is also useful where long-term exposure to light is required. Unlike formulations using epoxidized soya oils as the secondary plasticizer, those containing Plastolein 9213 afford non-tacky films even when it is used in amounts up to one-third the total plasticizer content.

Plastolein 9214 has a higher oxirane oxygen content than Plastolein 9213; consequently it has even better stabilizing action. It is suggested as a stabilizing plasticizer and can be used in conjunction with other plasticizers to contribute heat and light stability. It does not interfere with low-temperature flexibility nor does it build up the viscosity of the plasticizing system.

Plastolein 9232 can be used as a heat and light stabilizer as



E/25 is a superlative
i-oxidant for tyres, high
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This independent test fleet is located in Devine, Texas, some thirty-two miles southwest of San Antonio on U S Hiway 81. Sponsors have a choice of three routes from which to choose. Test procedures are flexible. Tire rotation, cycle miles, number and frequency of reports or routing, can be a basis for discussion if the sponsor so desires. We endeavor to operate to the best advantage of the sponsor. Because we are wholly independent of any organization, all information collected is responsible to the sponsor only.

Tires of all specifications tested—both passenger car and truck. Your inquiries will receive prompt attention.

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Phone Morris 3-4428 DEVINE, TEXAS P. O. Box 353

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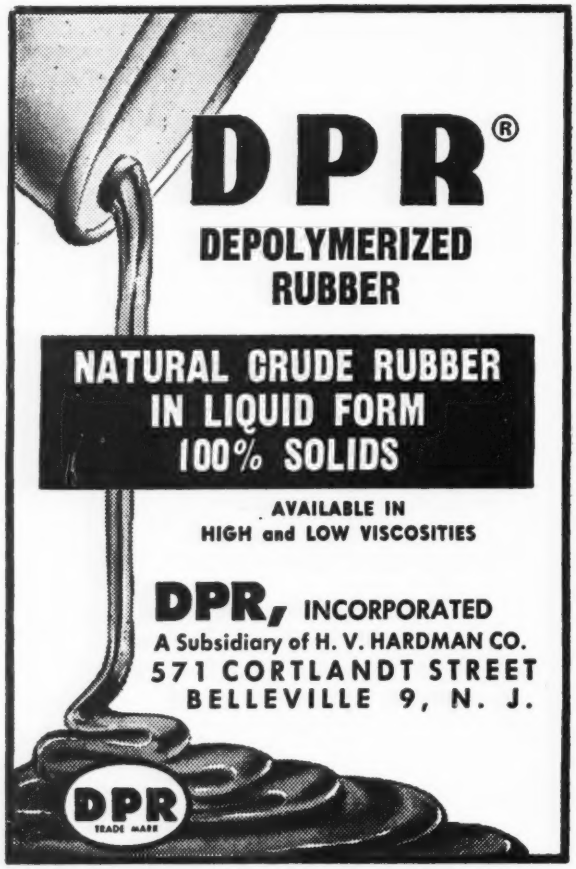

New Materials

part of either the vinyl stabilizing system or of the plasticizer system. As the amount of it is increased, the stabilizing properties are proportionately increased. It can also be used as a secondary plasticizer and is recommended where permanence is of prime importance. It contributes low carbon volatility loss, excellent resistance to water and mineral oil extraction, and good soapy water resistance to polyvinyl chloride and its copolymers.

Some typical specifications of these plasticizers have been reported as follows:

	Plastolein 9213	9214	9232
Oxirane oxygen, % min	3.1	4.0	6.0
Iodine value, max	2.5	3.0	2.5
Acid value, max	1.0	1.0	1.0
Color, Gardner, max	4	4	2

A technical bulletin, No. 413, giving more detailed information and formulation results, is available from the company.

Nitrile Silicone Rubbers

Three nitrile silicone rubbers are available in evaluation quantities from the silicone products department, General Electric Co., Waterford, N. Y. The three synthetic rubbers, designated NSR-X5602, NSR-X8701, and NSR-X4803, are said to be resistant to a variety of oils, fuels and solvents which cause many other rubbers to swell excessively and lose their elastomeric properties. Nitrile silicone rubber is useful over the entire —100 to 500° F. temperature range of regular silicone rubber. Below are listed the properties of the first three NSR rubber grades, designed for use in fabricating mechanical rubber parts.

NSR-X5602 is a 60 durometer rubber with intermediate fluid resistance, intended for intermittent contact with high swell fluids or continuous immersion in milder fluids. It is a relatively low modulus stock, intended for such applications as airframe seals, boots, diaphragms and shock mounts fabricated by extrusion, molding, or calendering.

NRS-X8701 is a 70 durometer nitrile silicone rubber with superior high-temperature oil resistance, suitable for molded O-rings, gaskets, and oil seals continuously immersed at elevated temperatures.

NRS-X4803 is an 80 durometer rubber with intermediate resistance to high-temperature fluids, designed principally for oil seals for automotive transmissions. It will also be useful in O-rings, gaskets, or similar molded, extruded, or calendered parts, for use where fluids encountered are not severe in effect or immersion is not continuous.

Some typical physical properties of these nitrile silicone rubbers are reported as follow:

Compound:	NSR-X5602	NSR-X8701	NSR-X4803
Oven cure	1 hr./ 400° F.	16 hrs./ 450° F.	16 hrs./ 400° F.
Specific gravity	1.2	1.25	1.4
Density, lb./cu. in.	0.043	0.045	0.50
Hardness, durometer A, ±5	60	70	80
Tensile strength, psi	1000	650	850
Elongation, %	260	125	125
Tear resistance, Die B, ASTM D 624, pi	80	50	75
Compression set, Method B, ASTM D 395, 22 hrs./300° F., %	60	45	35
Stiffness temperature	below −100° F.	below −90° F.	below −100° F.
Brittle temperature	below −120° F.	below −100° F.	below −120° F.

Preliminary product data sheets on these three nitrile silicone rubbers including vulcanizate data are available from the company.

New from Pennsalt . . .

POSITIVE PROTECTION

FOR YOUR PRODUCTS

with PENNOX® antioxidants

The PENNOX series provides an effective age resister for nearly every rubber manufacturing and compounding situation. PENNOX antioxidants protect Hevea and SBR vulcanizates, raw SBR polymer, and latex products from the deteriorating effects of heat and oxidizers. One of them is ideally suited to your compound.

GENERAL PURPOSE AMINE TYPE

PENNOX A—general purpose alkylated diphenylamine antioxidant for belting, tires, soles and other products in which a slight discoloration is not important . . . and a fully effective age resister for latex film and foam products.

NONSTAINING, NONDISCOLORING PHENOLIC TYPES

PENNOX B—good antioxidant for Hevea and SBR vulcanizates and for raw SBR polymer, not recommended for latex.

PENNOX C—exceptionally resistant to discoloration in light colored latex products; provides good protection for Hevea and SBR vulcanizates.

PENNOX D—nonstaining, nondiscoloring antioxidant for latex film products and dry Hevea and SBR compounds.

For detailed information on the PENNOX series ask for Bulletins S-151—PENNOX ANTIOXIDANTS; and S-152—PENNOX ANTIOXIDANTS FOR LATEX. Evaluation samples available on request.

See our Catalog in Chemical Materials Catalog

Pennsalt Chemicals ESTABLISHED 1850

INDUSTRIAL CHEMICALS DIVISION

PENNSALT CHEMICALS CORPORATION

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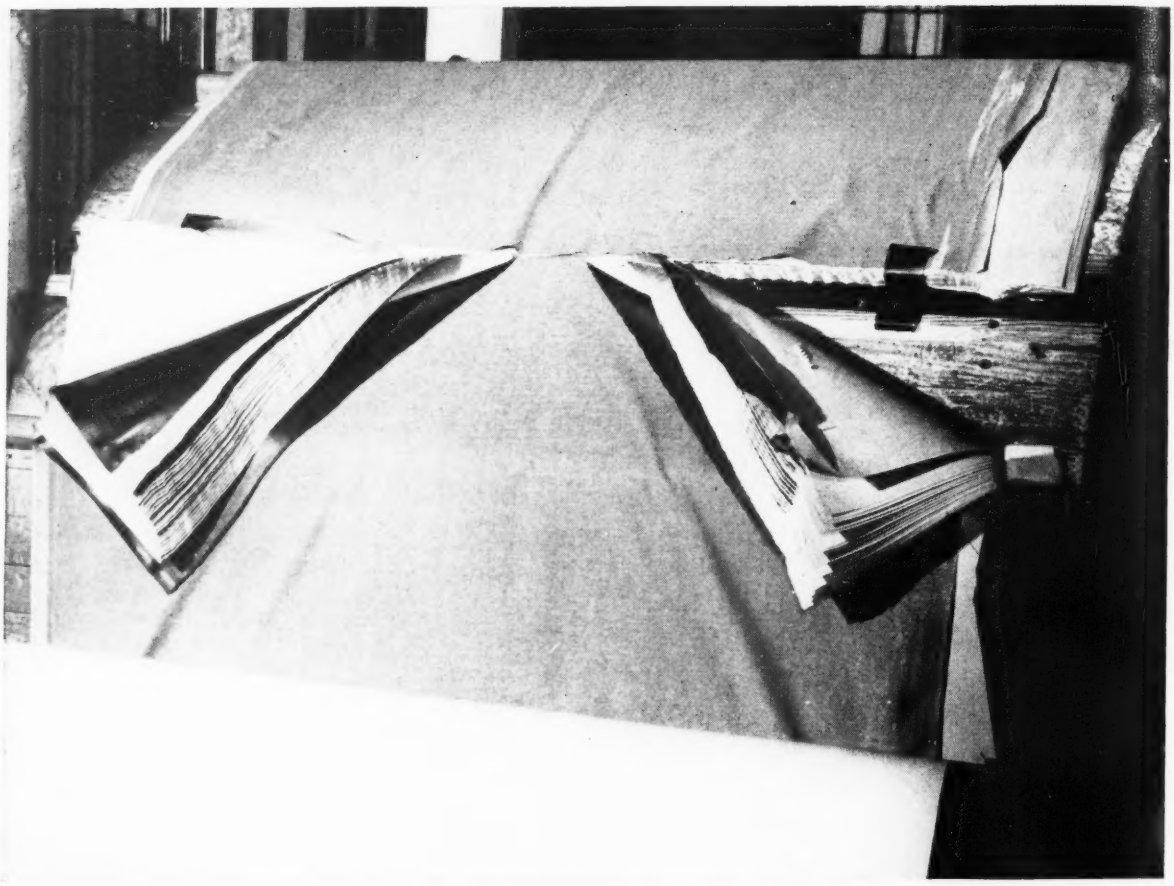

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Linerette separating paper plied up with frictioned stock before being cut in the clicking operation, saves time and money. Since 1925 Linerette, the specially processed separating paper, has been used with steadily increasing acceptance. It assures clean, fast separation without adhesion and contains no oil or wax. Here is how Linerette can help you:

Preserves tack.

Protects lightweight stock in shipment—no fabric needed.

Keeps stock free of cloth marks or impressions.

Clippings may be mixed with scrap and worked away when used in die-cutting operations.

Where cleanliness is essential, Linerette is a low cost lining for trays and containers.

Stocks can be calender-fed into it.

Used with most types of lightweight stocks in sheets or strips.

Linerette is available in any width up to and including 54," in rolls of 9", 11½", 13" and 15" diameters, on cores of 3" i.d. The yield is approximately six square yards to the pound. A 9" roll contains 375 linear yards and a 15" diameter about 1150 linear yards. Ask for a sample today, just specify desired width.

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Illustrated booklet tells about Climco Liners and Linerette separating paper. Tells how to get better service from liners. Write for your copy now.

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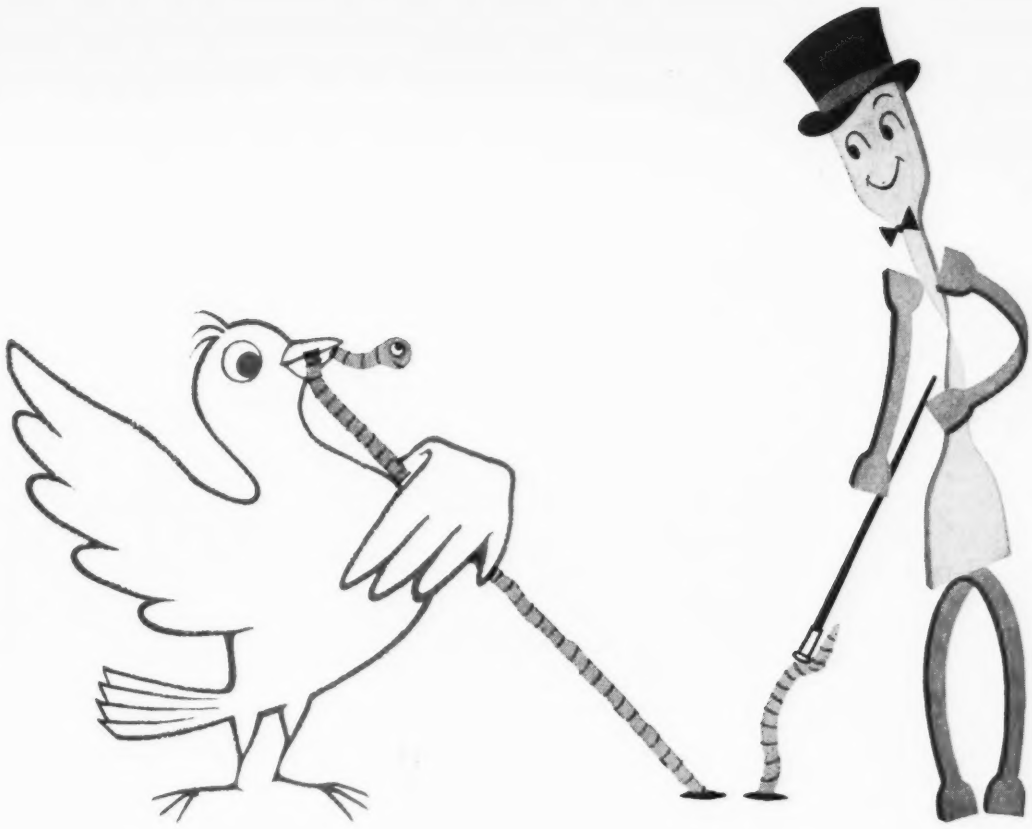
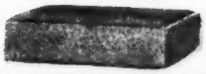
INTERLEAVING PAPER

MADE BY THE MANUFACTURERS OF CLIMCO PROCESSED LINERS



You get easy extrusions with Philprene*!

CURRENT PHILPRENE POLYMERS

	NON-PIGMENTED 	PIGMENTED WITH PHILBLACK
HOT	PHILPRENE 1000 PHILPRENE 1009 PHILPRENE 1001 PHILPRENE 1010 PHILPRENE 1006 PHILPRENE 1018 PHILPRENE 1019	
COLD	PHILPRENE 1500 PHILPRENE 1502 PHILPRENE 1503	PHILPRENE 1601 PHILPRENE 1605
COLD OIL	PHILPRENE 1703 PHILPRENE 1706 PHILPRENE 1708 PHILPRENE 1712	PHILPRENE 1803 PHILPRENE 1805

Operational difficulties are for the birds! The correct Philprene rubber will give you easy extrusions, plus superior physical properties as well! For cable jackets, try Philprene 1605 or Philprene 1706. Makers of hard rubber products can improve mold flow and get smooth, true-to-the-die accuracy with Philprene 1708. There are many other Philprenes compounded for fabricated or calendered goods . . . for light-colored items . . . for applications where extra toughness and durability are required.

Check with your Phillips technical representative. It's his job to help you every step of the way from recipe to finished product. His technical knowledge and Phillips long experience with rubber, plus the facilities of an up-to-date technical service laboratory, are at your service. This valuable technical assistance can mean a definite increase in your profits.

*A trademark

PHILLIPS CHEMICAL COMPANY

Rubber Chemicals Division, 318 Water St., Akron 8, Ohio.

District Offices: Chicago, Dallas, Providence and Trenton.
West Coast: Harwick Standard Chemical Company, Los Angeles, California.
Warehouse Stocks at Akron, Boston, Chicago, and Trenton
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What happens when you

add a pinch of permanence?

When you're trying to give a shoe-sole compound more of the qualities you want it to have, don't forget this powdered resin.

A little of it, in an SBR compound, can increase the hardness and boardiness.

A little more—on the order of 20 parts to 100 of elastomer (with some nitrile as a common flux)—can further improve hardness and stiffness, as well as resistance to abrasion and heat distortion.

It reduces tensile strength *less* than a thermoplastic resin would. Because it is heat-setting, the properties it brings to the stock stay there through higher temperatures—as high as 250°F.

You get more durability—more permanence—than with other types of resins. You pay less for it.

This is just one of 33 Durez resins helping compounders make better rubber products. Some of these resins harden and reinforce nitrile rubber. Others add permanence traits to natural rubber and Neoprene. Still others strengthen the grip of solvent-type adhesives, or bond nitrile rubber to metal during molding.

To meet your processing conditions, you can get these resins in powder, lump, liquid, and emulsion forms. If you'd like to know more about them, write for the illustrated bulletin, "Durez Resins in the Rubber Industry."

DUREZ PLASTICS DIVISION

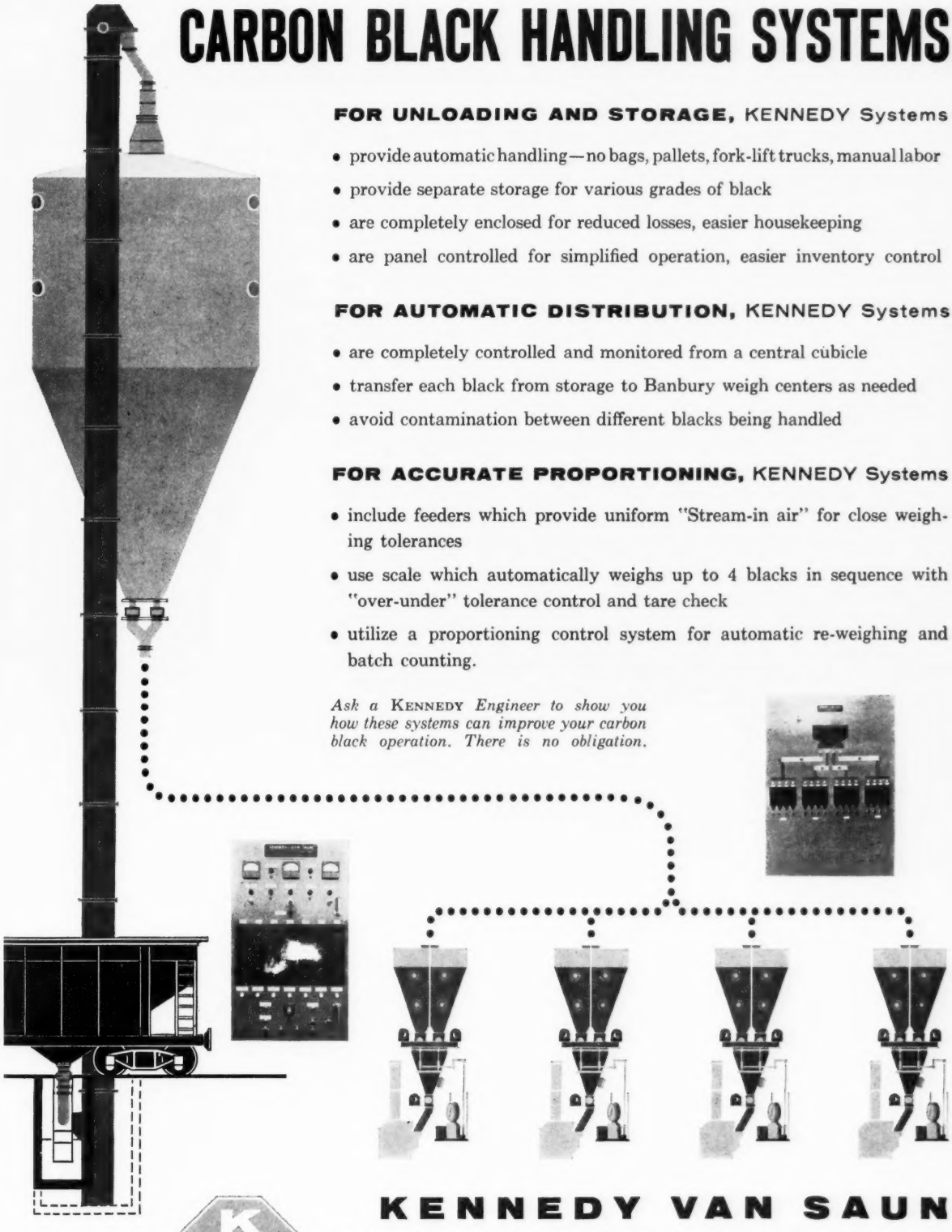
205 WALCK ROAD, NORTH TONAWANDA, N. Y.

HOOKER CHEMICAL CORPORATION

HOOKER CHEMICALS PLASTICS

KENNEDY

CARBON BLACK HANDLING SYSTEMS



FOR UNLOADING AND STORAGE, KENNEDY Systems

- provide automatic handling—no bags, pallets, fork-lift trucks, manual labor
- provide separate storage for various grades of black
- are completely enclosed for reduced losses, easier housekeeping
- are panel controlled for simplified operation, easier inventory control

FOR AUTOMATIC DISTRIBUTION, KENNEDY Systems

- are completely controlled and monitored from a central cubicle
- transfer each black from storage to Banbury weigh centers as needed
- avoid contamination between different blacks being handled

FOR ACCURATE PROPORTIONING, KENNEDY Systems

- include feeders which provide uniform "Stream-in air" for close weighing tolerances
- use scale which automatically weighs up to 4 blacks in sequence with "over-under" tolerance control and tare check
- utilize a proportioning control system for automatic re-weighing and batch counting.

Ask a KENNEDY *Engineer to show you how these systems can improve your carbon black operation. There is no obligation.*

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MANUFACTURING & ENGINEERING CORPORATION

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Polyisoprene rubber...

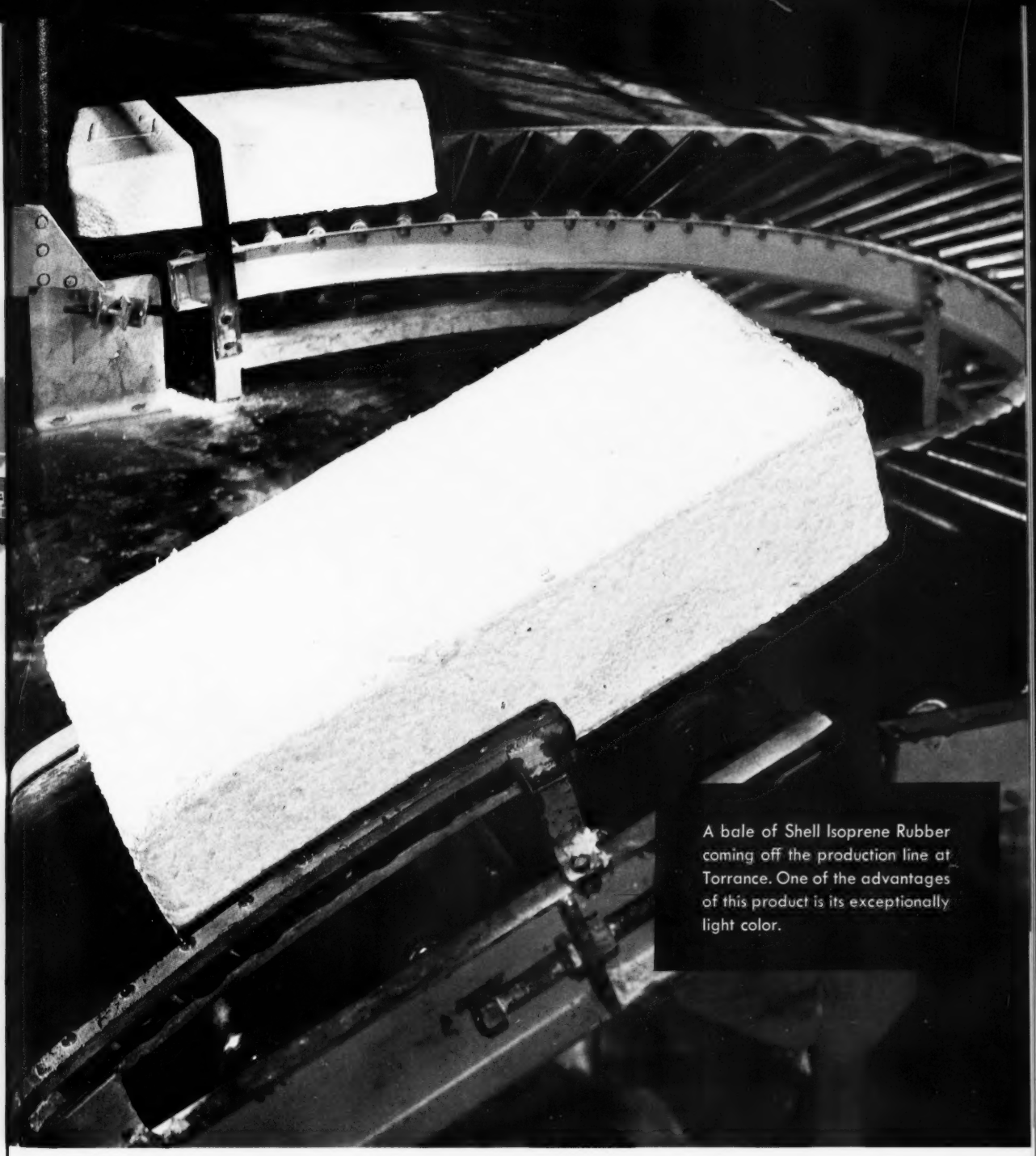
—now available in tonnage quantities

As one result of an extensive research and development program, Shell Chemical is now producing at Torrance, California, the world's first commercial synthetic polyisoprene rubber.

Now available in limited tonnage quantities for your evaluation, Shell Isoprene Rubber will soon be available in larger amounts when installation of additional facilities is completed.

This new polymer is closely similar to natural rubber in chemical and physical properties. It is excellent in color and uniformity, and offers the security of near-by availability of a man-made product.

Your letterhead request will bring technical information . . . samples for your evaluation.



A bale of Shell Isoprene Rubber coming off the production line at Torrance. One of the advantages of this product is its exceptionally light color.

SHELL CHEMICAL CORPORATION

SYNTHETIC RUBBER DIVISION, P. O. BOX 216, TORRANCE, CALIFORNIA

SHELL

Call Hall

HALLCO NEWS

Issued by
The C. P. Hall Co.
Chemical Manufacturers

STABILITE INCREASES EFFECTIVENESS OF DIARYL AMINE ANTIOXIDANTS ...AT A SAVINGS IN COST TO YOU!

Stabilite, a chemical of the diaryl ethylene diamine series, increases remarkably the effect of other commercial age resistors. In combination with diaryl amine antioxidants, Stabilite provides outstanding resistance to oxidation for all rubber compounds through a full range of temperatures. It imparts unusual flexing properties, minimum discoloration, and lowers cracking effects due to sunlight. Even in small quantities, Stabilite produces greater smoothness in calendering and tubing, gives unusually fine plasticity, lessens sunchecking and enhances flex resistance.

Unlike the diaryl amine antioxidants, Stabilite functions with them to extend their total effectiveness. Since it is completely different chemically, it causes a reaction which actually doubles the value of the diaryl amine antioxidants. In tests conducted in our laboratories, 0.5% Stabilite plus 0.5% common diaryl amines showed effectiveness greater than 1% of either used alone. Through the proper use of Stabilite, processors of rubber compounds can enjoy reduction in costs while definitely improving the antioxidant properties of their products. For a complete report on antioxidant tests using Stabilite and commercial diaryl amines write or call the C. P. Hall Company, Akron, Ohio.

Stabilite is successfully used by manufacturers of air-bags, belting, hose, molded goods, automotive rubber items and tires.

The C. P. Hall Co.
CHEMICAL MANUFACTURERS

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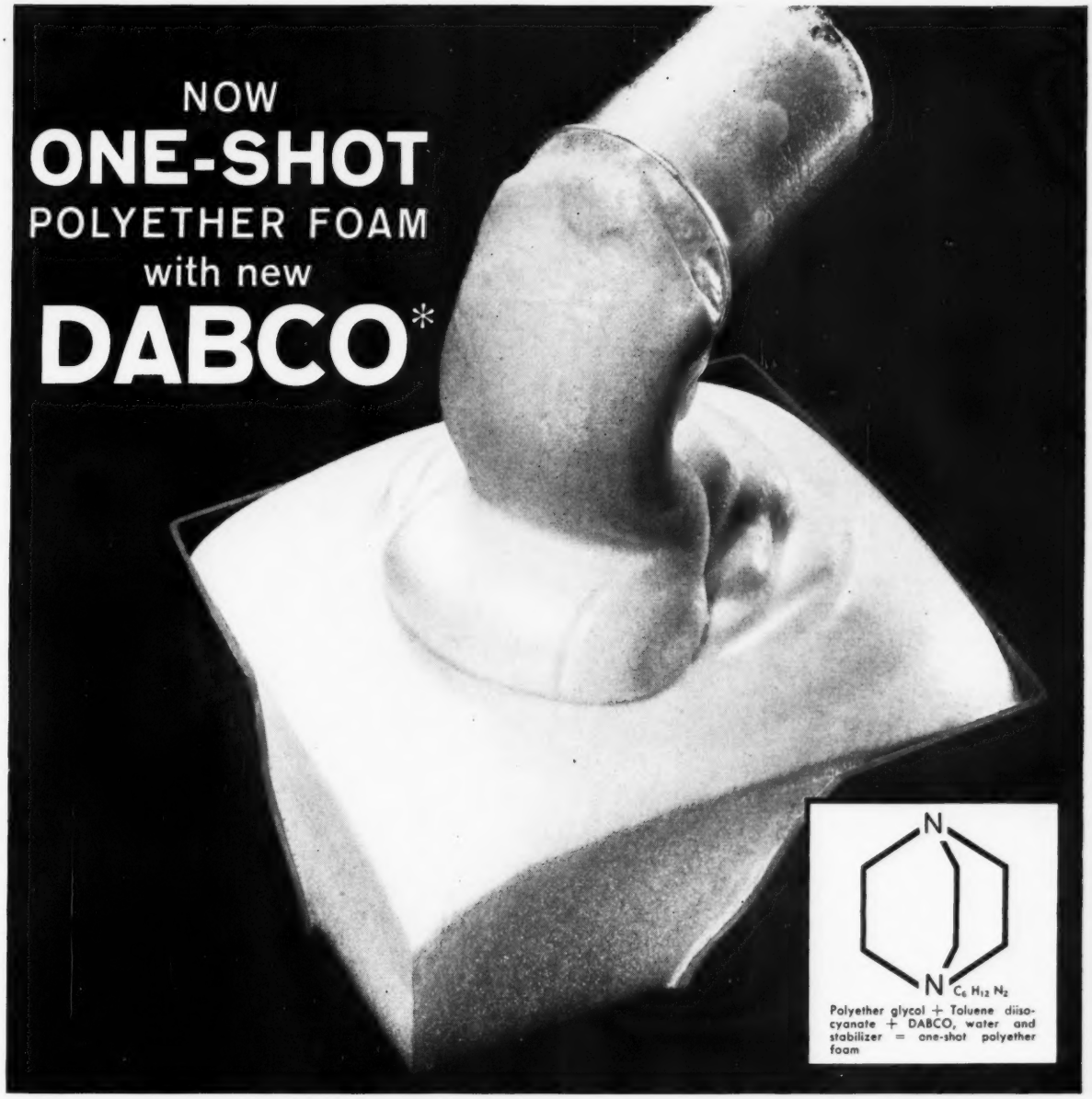

Now, you can produce odorless, flexible, semi-rigid or rigid urethane foams from all commercial urethane grade polyols . . . *in one simple, economical operation.* New DABCO gives you these production advantages:

- Fast cure • Prepolymer step eliminated
- Process in existing equipment
- Low catalyst concentration economy

DABCO produces foams with such good physical properties as:

- Low compression set • Uniform cell structure
- Excellent tensile, tear strength and elongation
- Dimensionally stable • Resistant to humid aging
- Good molding characteristics • No odor

DABCO is now used commercially here and abroad to produce polyether prepolymer and adipic acid ester type crash pads and polyether prepolymer and dimer acid ester foams for seating and load-bearing applications. Other fields are being explored for new DABCO, for which your inquiries are invited.

Write for complete information.

*HOUDRY PROCESS CORPORATION TRADEMARK FOR TRIETHYLENEDIAMINE

The structure and properties of DABCO suggest the following other possible areas of interest:

- Chain transfer agent in radical catalyzed polymerizations
- Activator for peroxide catalyzed polymerization
- Transesterification and cyanoethylation catalyst
- Complexing agent for metals

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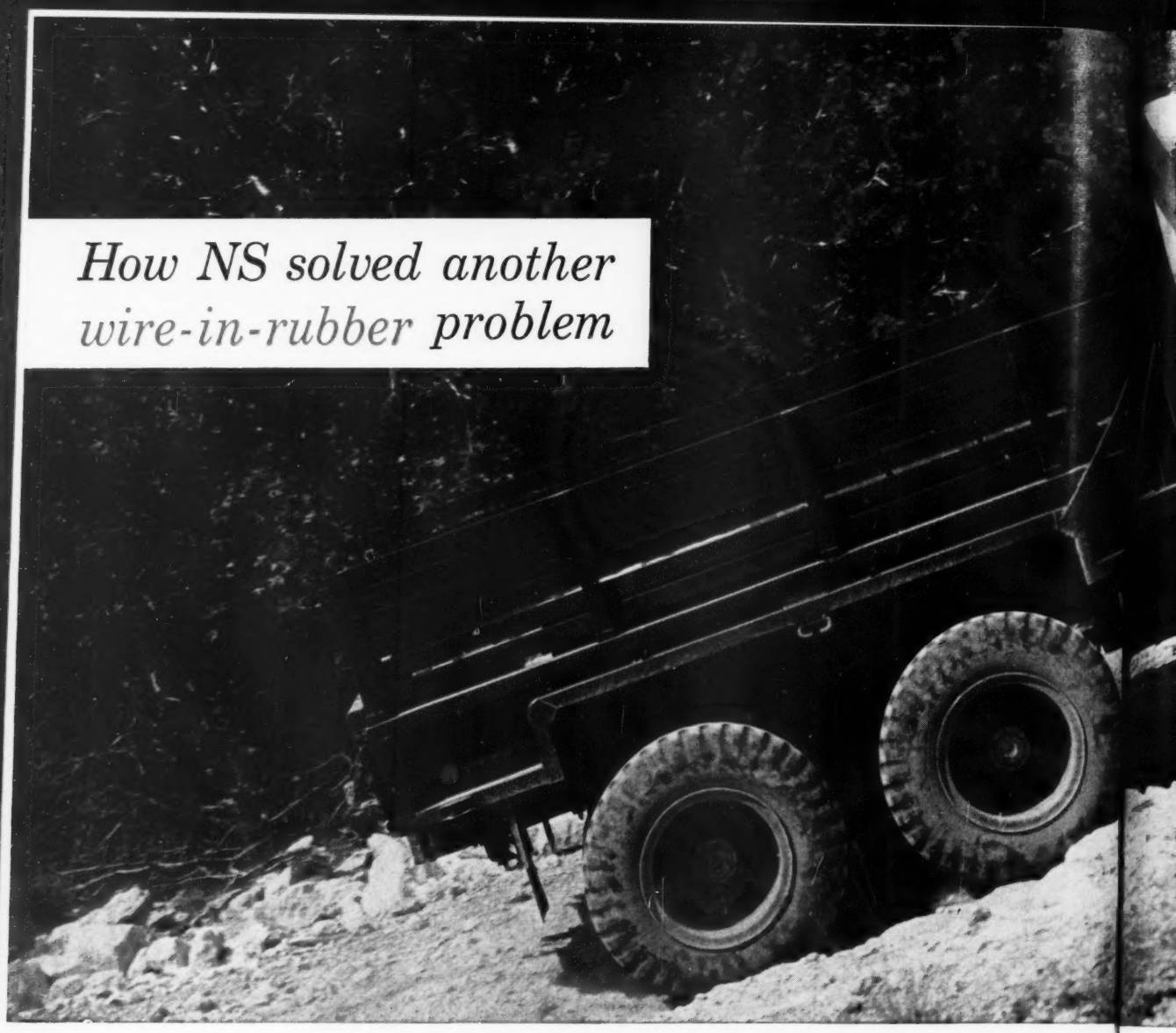
PROCESS CORPORATION
1528 Walnut Street, Phila. 2, Pa.

HOUDRY means Progress . . through Catalysis



How NS solved another wire-in-rubber problem

NATIONAL-STANDARD DEVELOPS SPECIAL BEAD WIRE FOR BUTYL TIRES

When several major tire manufacturers began experimenting with butyl rubber for passenger and military vehicle tires, a major problem was encountered—to develop a bead wire finish and butyl stock that provided the necessary adhesion.

NATIONAL-STANDARD engineers were called in by the tire manufacturers to develop a bead wire that would have the needed adhesive properties. Without such a bead wire, it would not be possible to utilize butyl in tires. Months of intensive experimentation and testing were spent by National-Standard engineers on a wide variety of metallic wire finishes, as well as fabricated braid and Pierce tape. These fabricated bead wires have proved particularly successful.

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RESULT—From these two concurrent research projects came the development of a bead wire and several butyl compounds which will provide satisfactory adhesion to meet tire manufacturers' special needs. Tire manufacturers have begun field testing of new butyl tires with National-Standard bead wire.

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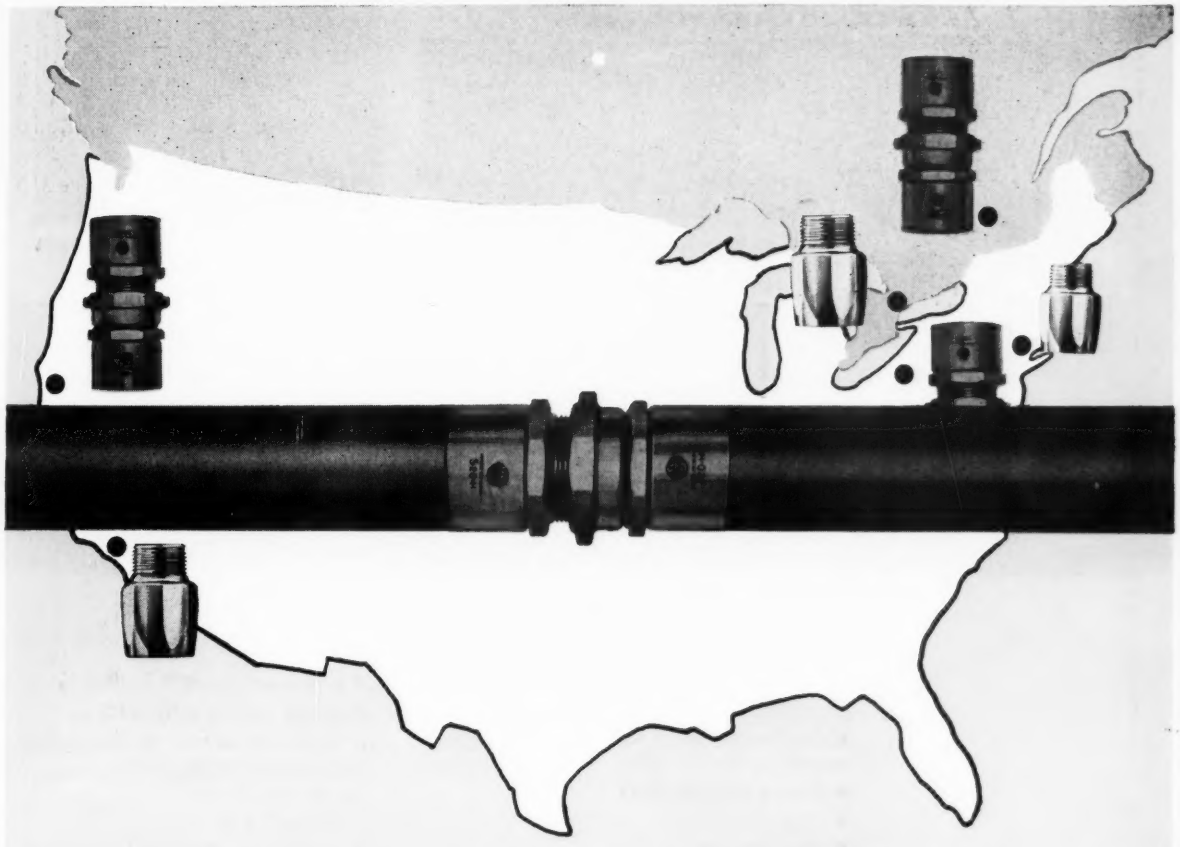

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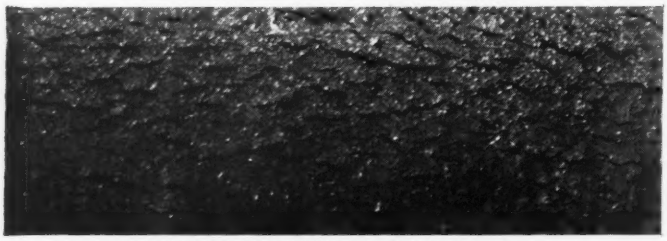
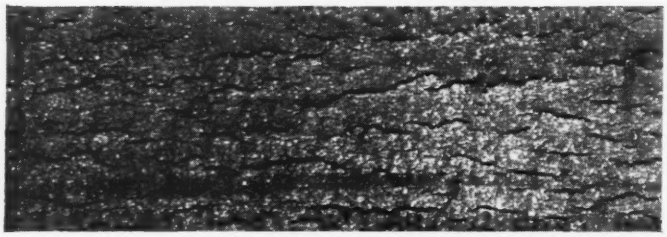
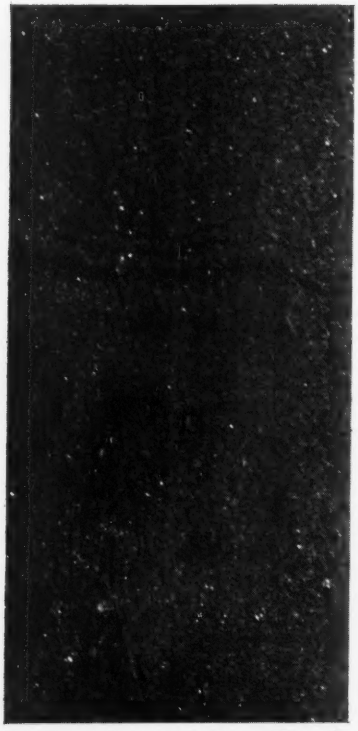


ANTIOZONANT–Y-1.7 pph





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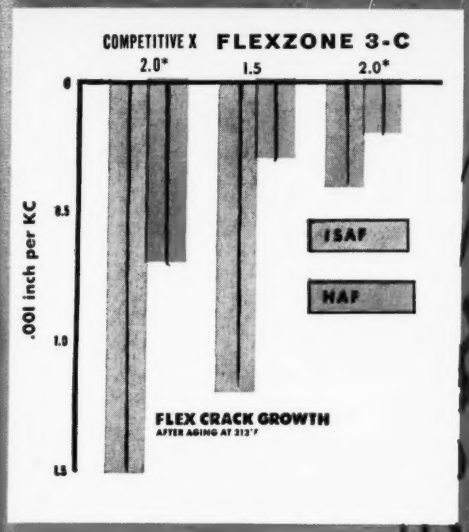

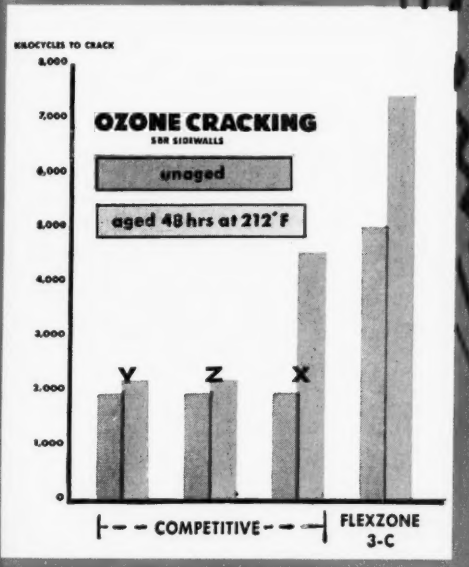

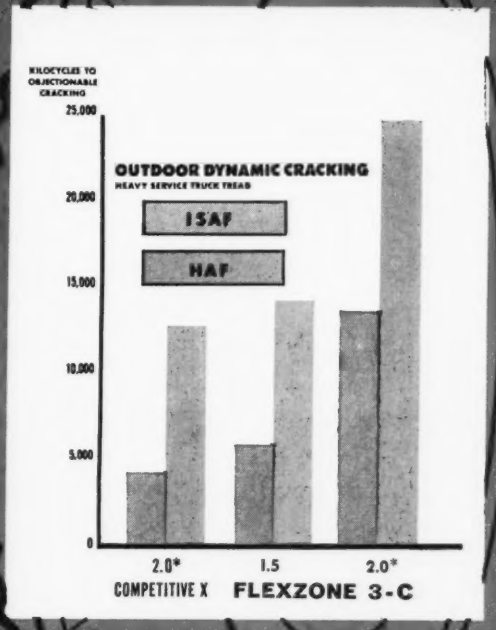

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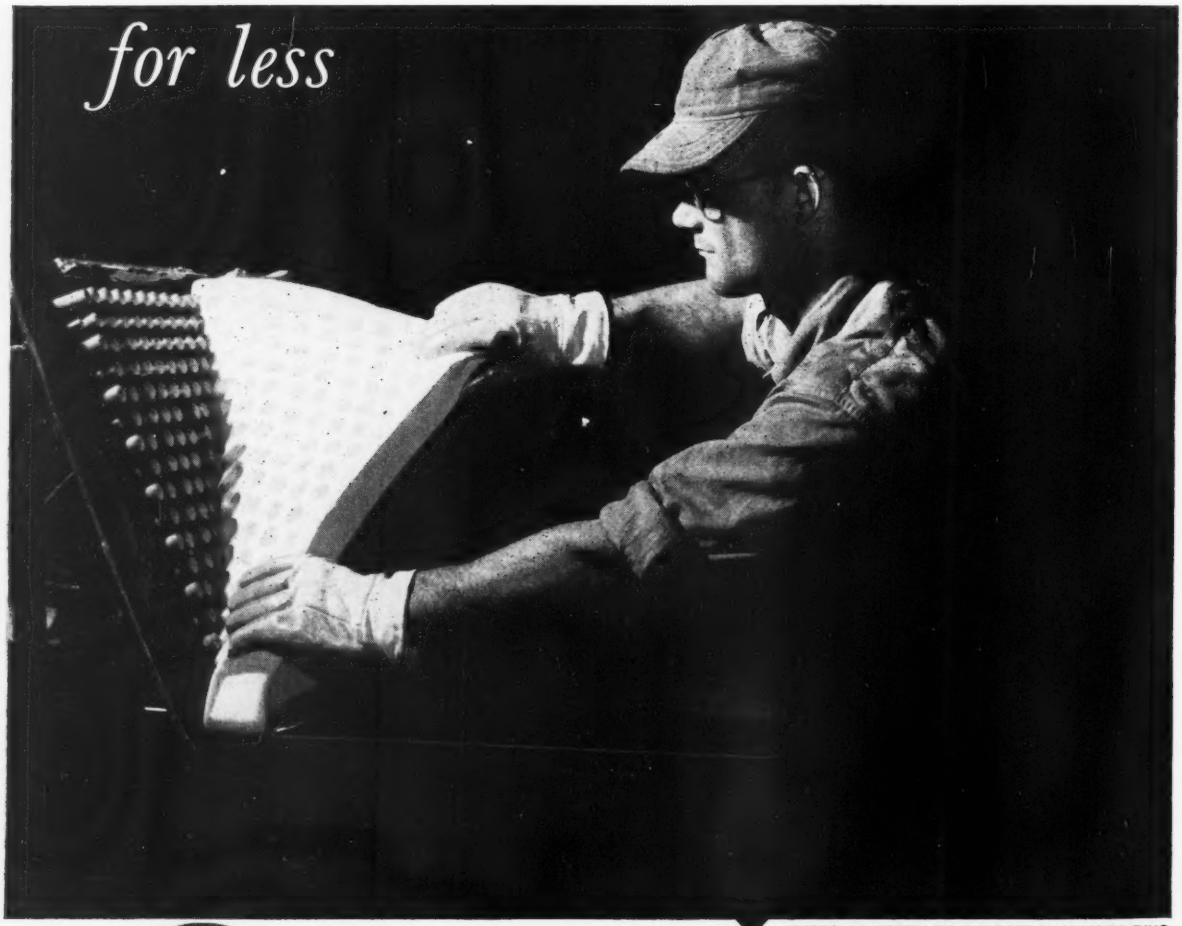

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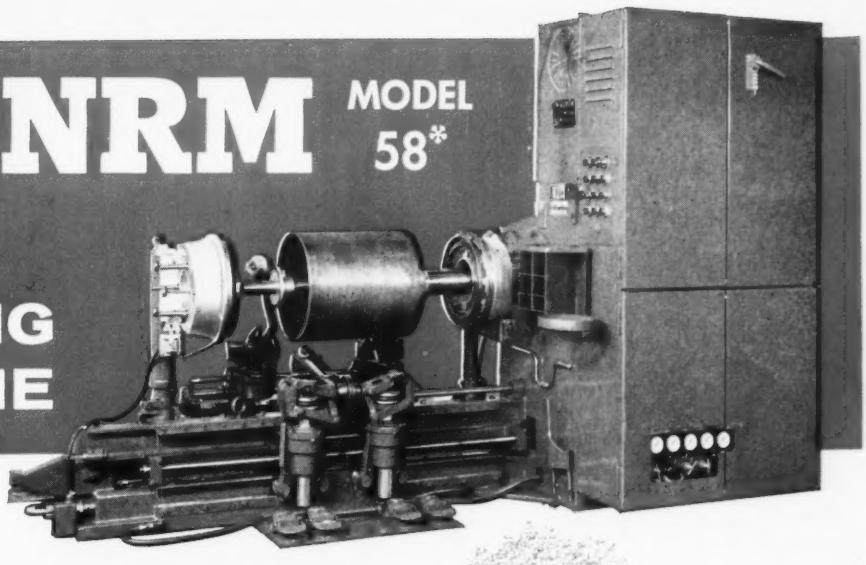

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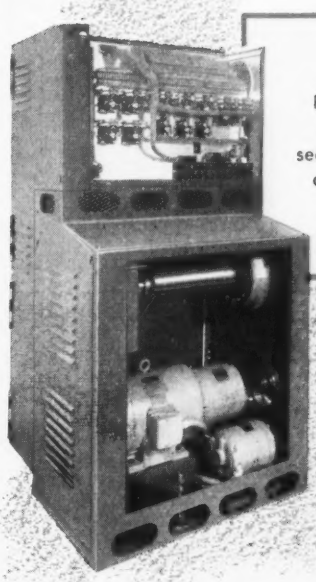

Rear view showing sequence timer and motors

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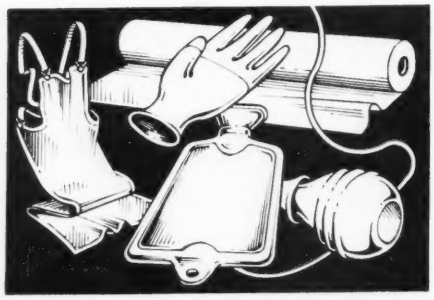

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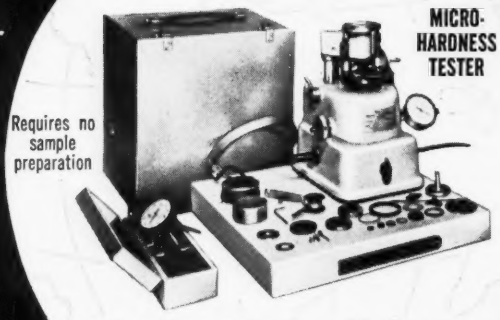

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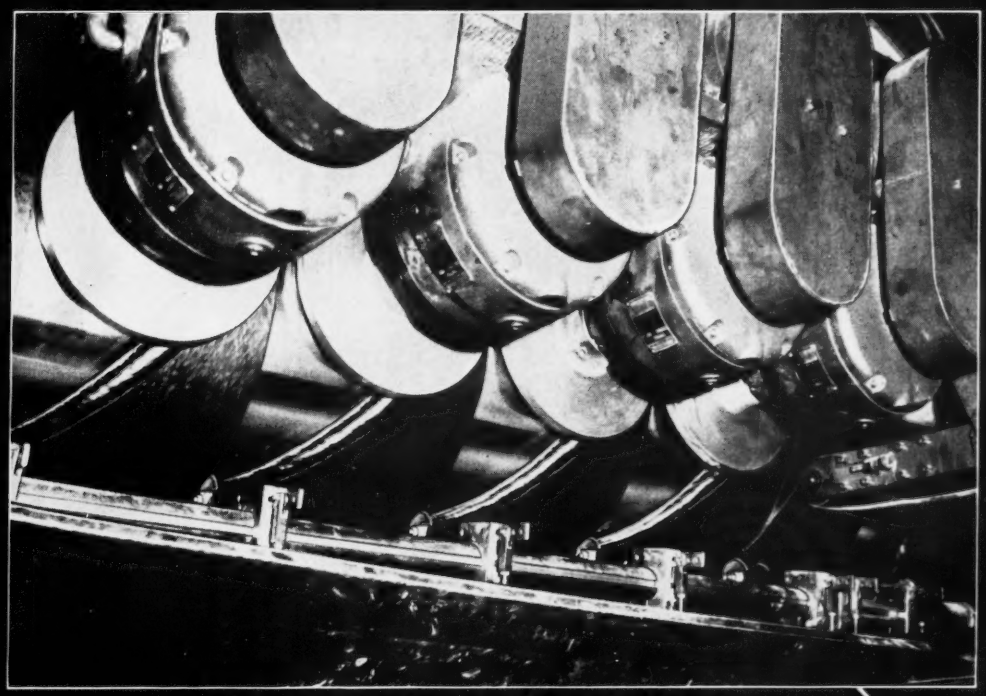

Curling cut strips advance stock from feed-in end at left to automatic discharge at right.

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RUBBER WORLD
EDITORIAL

Some SBR Producers Should Take Another Look at ASTM Numbering

RUBBER WORLD has been conducting a campaign since July, 1958, to explain the procedure developed in 1956 by the American Society for Testing Materials Committee D-11 on Rubber for the classification and description of styrene-butadiene rubbers (SBR's). This procedure, now designated as ASTM D 1419-58T, Tentative Recommended Practices for Description of Styrene-Butadiene Rubbers, was developed for the benefit of the SBR producers when they purchased these synthetic rubber plants in 1955 from the government. It provides a means of continuing the former GR-S code numbers for established commercial grades of SBR and of designating new grades which do not conform to the established types, as they are developed.

In ASTM D 1419, Table II lists in their proper classification, that is, as hot rubber, cold rubber, masterbatched rubber, etc., established types which have gained commercial acceptance. Table I gives a list of the private producers and a range of 500 code numbers for each that have been assigned for designating new grades that do not conform to the types in Table II. In addition, the range of 500 numbers assigned to each producer in Table I has been further divided in groups of 50 by product types. Most of the 12 SBR producers in this country and Canada have used the Table I system, but some have not.

As pointed out on this page in July and December, 1958, SBR producers and consumers alike have much to gain from the use of the ASTM D 1419, Table I code system. A survey made by RUBBER WORLD since December, 1958, for the purpose of preparing an up-to-date table of all SBR's used commercially has shown that as of late April there are 143 different grades of dry SBR on the market, 50 of which are coded according to ASTM D 1419, Table II for established grades; 46 according to Table I for new grades; and 47 according to four different systems of three American and one Canadian producer.

When this up-to-date table of available dry SBR's is published in the June issue of RUBBER WORLD, it should become evident that it would be easier for all concerned if the individual coding systems of some SBR producers for new rubbers were discontinued in favor of the ASTM system. How much easier it would be, for example, if Shell Chemical's OB-102, CB-102, and OB-113, all cold rubber carbon black masterbatches, were designated with the assigned ASTM numbers between 7650 and 7699! The numbers 7500-7999 mean Shell Chemical, and within these 500 numbers, 7650-7699 means cold rubber black masterbatches. Shell Chemical's OB-104, OB-106, OB-111, all cold rubber oil-black masterbatches, should be numbered between 7750 and 7799 in order to identify them more clearly from the similar OB numbers for cold rubber black masterbatches without oil. United Rubber & Chemical Co. and Firestone Synthetic Rubber & Latex Co. have many specially coded grades that would also be more clearly identified by the ASTM D 1419, Table I system.

R. G. Seaman

EDITOR

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RUBBER WORLD

Accelerated Testing Of Ozone Cracking Inhibitors[1]

By F. B. SMITH and W. F. TULEY
Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn.

ACCELERATED ozone cracking tests have been studied in relation to performance of several commercial antiozonants used in tire treads and sidewalls. Relations among the accelerated ozone box tests, outdoor static and dynamic tests, viscosity degradation tests, and actual tire performance are surveyed and studied. Typical data from this work are shown, demonstrating the relative effectiveness of several commercial antiozonants in tread and sidewall compounds. The proper use of waxes is also illustrated. Emphasis is placed on providing a practical level of ozone cracking resistance.

Discussion

Ozone cracking of rubber products may occur under either static or dynamic conditions. In the case of a tire both forms of cracking are to be expected. Therefore a really effective antiozonant should provide both static and dynamic ozone resistance.

The three chemical ozone cracking inhibitors considered in this work are listed in Table 1. Also shown are the respective abbreviations by which each chemical will be identified in subsequent sections.

In the research program at Naugatuck, both accelerated and unaccelerated tests are used to screen and select commercial ozone cracking inhibitors. These include both static and dynamic tests with both accelerated and unaccelerated static tests. The accelerated static tests were run according to ASTM D 1149-55T[3] both in the Crabtree box[4] using 25 p.p.h.m. of ozone and in the Mast box[5] using 50 p.p.h.m. of ozone. The unaccelerated static tests were run according to ASTM D 518-44 on the roof of the plant at Naugatuck, Conn., and on the roof at the plant at Los Angeles, Calif. The dynamic tests were run on the roof at Naugatuck on a Naugatuck-Holbrook machine described below and at Los Angeles on an outdoor weathering wheel described later in the Los Angeles section of this report.

TABLE 1. ANTIOZONANTS TESTED

Chemical	Abbreviation
1. N-phenyl N′cyclohexyl p-phenylene diamine	P.C.p.p.d.*
2. 6-ethoxy-1,2-dihydro-2,2,4-trimethyl-quinoline	E.D.T.m.q.†
3. N,N′-di-(1-ethyl-3-methyl-pentyl) p-phenylene diamine	$(EMP)_2$p.p.d.‡

*Flexzone 6-H,[2] Naugatuck Chemical Division.
†Santoflex AW, Monsanto Chemical Co., Akron, O.
‡UOP-88, Universal Oil Products Co., Des Plaines, Ill.

Naugatuck-Delman Antiozonant Screening Test

In addition to these tests which require vulcanized rubber samples, a chemical screening test is also used. The latter is run on crude SBR (styrene-butadiene rub-

[1]Presented before the Division of Rubber Chemistry, ACS, Chicago, Ill., Sept. 10, 1958.
[2]F. B. Smith, "Flexzone 6-H," Bulletin No. 220 (Feb., 1958).
[3]American Society for Testing Materials, Philadelphia, Pa.
[4]Modified equipment, not commercially available.
[5]Mast Development Co., Inc., Davenport, Iowa.

Accelerated Ozone Testing

The authors have taken some of the work done in their antiozonant studies to try to relate results found in accelerated ozone boxes, outdoor static and dynamic tests, viscosity degradation tests, and actual tire performance. While this study is limited to three commercial antiozonants and only four compounds based on natural and SBR rubbers, some deductions can be made regarding ozone testing.

One point made by the authors is well worth noting: the antiozonants tested were effective against normal atmospheric concentrations of ozone in the absence of wax although in accelerated tests in ozone boxes the degree of effectiveness of chemical ozone cracking inhibitors was largely masked. It is stated that ozone box exposures do not distinguish between certain compounding variables as used in this work.

A preliminary antiozonant screening test based upon a modification of the Delman test is described and is suggested along with wax protected ozone box compound screening as being beneficial in the early studies. It is pointed out that for final testing and actual use ratings, of all the laboratory tests used the dynamic outdoor test seems most relevant to actual tire performance.

The development of a weathering wheel test is described which does shorten considerably the time needed for use testing. Running the tires on a captive wheel set-up has shown very good correlation with road tests.

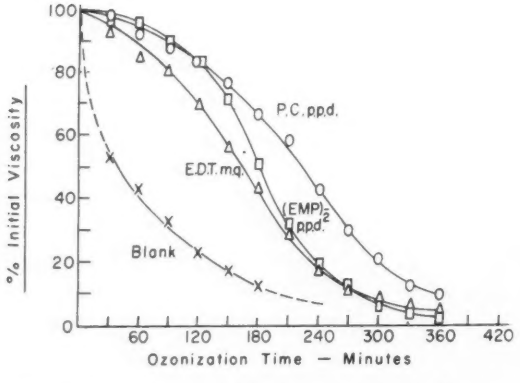


Fig. 1. Screening of chemical antiozonants by viscosity degradation using a modified Delman procedure. Ozone concentration used is 250 p.p.m.

ber) in solution and may be called the Naugatuck-Delman test since it is a modification of the procedure previously reported by Delman *et al.*[6] A stream of compressed air containing 250 p.p.m. ozone is used as the ozonizing medium. Ten parts of chemical are added per 100 parts SBR solution in o-dichloro-benzene. The flow rate of the ozonized air is 0.02-cubic meter per hour. Otherwise the Delman *et al.* procedure is observed. Periodic viscosity determinations are made with the Cannon, Fenske, Ostwald viscometer. Sharp drops indicate rapid chain cleavage and hence poor protective power for a given chemical.

Typical viscosity degradation curves are shown in Figure 1, comparing the antiozonants considered here. The persistence of inhibition is more marked for the P.C.p.p.d. than for either of the other commercial antiozonants. The blank was degraded quite rapidly. This relative picture of antiozonant effectiveness should be kept in mind as we proceed to examine the relations between the various tests for ozone cracking resistance.

Before discussing the test data, a description of the method of rating degree of cracking is desirable.

In all laboratory cracking tests at Naugatuck, ozone

[6] A. E. Delman, B. B. Simms, H. R. Allison, *Anal. Chem.*, 26, 1589 (Oct., 1954).

TABLE 2. COMPOUND FORMULATIONS

	Truck Tread		Passenger Sidewall	
	#1	#2	#1	#2
#1 Smoked sheets	100	100	50	—
SBR 1500	—	—	50	100
Naugatuck #667 reclaim*	—	—	30	30
HAF black	45	45	—	—
FEF black	—	—	40	45
Pine tar	4.5	—	—	—
Process oil	—	—	8	—
Paraflux†	—	—	—	8
Stearic acid	4.5	2	2	1
BLE-25‡	—	—	.75	1
Flexamine§	—	—	.70	1
Zinc oxide	4.5	4.5	3	3
Sunproof Improved Wax¶	as shown	as shown	as shown	2
Antiozonant	1.5	as shown	as shown	as shown
MBT	.6	—	—	—
Delac S‖	—	.45	.70	1.1
Sulfur	2.5	1.75	2.4	2.25
Cured 90′ at 292°F				
M-300—psi.	1500	1750	900	1030
Tensile—psi.	3470	2800	2200	2100
Elongation—%	530	410	550	550
Shore A hardness	66	59	60	63

*Whole tire reclaimed rubber, Naugatuck Chemical.
†Polymerized hydrocarbon, C. P. Hall Co., Akron.
‡Reaction product of diphenylamine and acetone, Naugatuck Chemical.
§65% complex diarylamine-ketone reaction product, 35% N,N′ diphenylene diamine (D.p.p.d.), Naugatuck Chemical.
¶Mixture of selected waxes, Naugatuck Chemical.
‖N-cyclohexyl-2-benzothiazole sulfenamide, Naugatuck Chemical.

cracking is rated in terms of typical laboratory cracking stages. These are shown in Figure 2. Ordinarily five stages are recognized.

1. Very, very slightly cracked (a 3 X glass may be used)
2. Very slightly cracked
3. Slightly cracked
4. Cracked
5. Very badly cracked

Table 2 illustrates the compounds used in this work.

Truck tread compound #1 is a conventional compound containing pine tar and stearic acid. In truck tread compound #2 certain of these ingredients, previously reported by Cox[7] as being detrimental to the activity of $(EMP)_2$ p.p.d., are not used. The passenger sidewall compound #1 contains 50 parts each of natural rubber and SBR 1500; while passenger sidewall compound #2 is based on 100 parts of SBR 1500. The two sidewall compounds feature the use of Sunproof Improved Wax. The tread compounds contain no wax.

Static Tests in Ozonized Air

The curves shown in Figure 3 compare the rate of cracking for tread compound #1 in the Crabtree box and in the Mast box. Doubling the ozone concentration roughly doubles the rate of cracking. The salient fact here is that the addition of 1.5 parts of any of the three chemical antiozonants studied had no perceptible effect in inhibiting the rate of ozone cracking in either accelerated test.

The curves shown in Figure 4 demonstrate first that the addition of 1% Sunproof Improved Wax to tread compound #1 significantly inhibits its rate of ozone cracking in the Crabtree ozone box. Secondly, the addition of 1% Sunproof Improved Wax in combination with 1.5% P.C.p.p.d. to tread compound #1 effects a much larger improvement in the resultant resistance to accelerated ozone aging.

In Figure 5 two general curves are reported for combinations of the three antiozonants exposed at 50 p.p.h.m. ozone in the Mast box. Some compounds contained small amounts of wax and up to four parts of antiozonant.

[7]W. L. Cox, "Chemical Antiozonants and Factors Affecting Their Utility," p. 57, "Symposium on Effect of Ozone on Rubber." ASTM Special Publication No. 229 (1958).

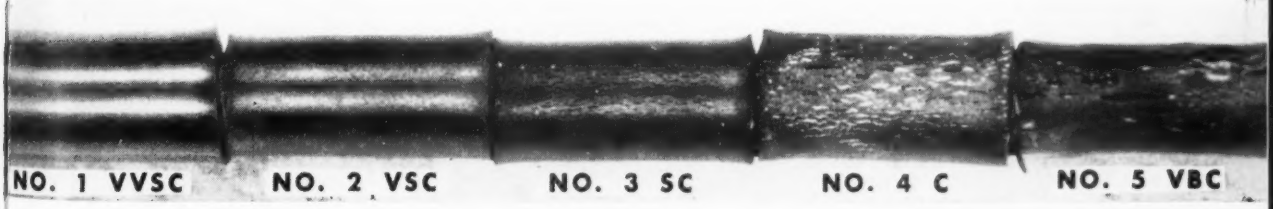


Fig. 2. Comparison samples for visual rating of ozone cracking of rubber parts. VVSC—very, very slightly cracked; VSC—very slightly cracked; SC—slightly cracked; C—cracked; and VBC—very badly cracked

William F. Tuley

Frank B. Smith

The Authors

William F. Tuley, group section manager, rubber and agricultural chemicals, research and development department, Naugatuck Chemical Division of United States Rubber Co., received his B.S. in chemical engineering at Oregon State College and his Ph.D. in organic chemistry at the University of Illinois.

Following a short connection with the Celotex Co., Chicago, Ill., Dr. Tuley joined U. S. Rubber and served first in the research center from 1928 to 1934, when he transferred to the Naugatuck Division. He has served in several capacities in sales and manufacturing as well as in research.

Dr. Tuley is a member of Sigma Xi, Alpha Chi Sigma, Phi Kappa Tau, and the Naugatuck Chamber of Commerce as well as being active in the ACS, its Division of Rubber Chemistry, and the New York and Connecticut Rubber groups.

Frank B. Smith, rubber technologist, Naugatuck Chemical Division, received his B.S. in chemistry from the University of Massachusetts.

Mr. Smith held several positions in tire compounding and process development in Fisk Tire and U. S. Rubber tire plants before joining the Naugatuck division in 1955. He has been granted four patents in the tire field and has others pending.

A member of the ACS and its Rubber Division, Mr. Smith is the current treasurer of the Connecticut Rubber Group and is a member of the Detroit and New York groups as well.

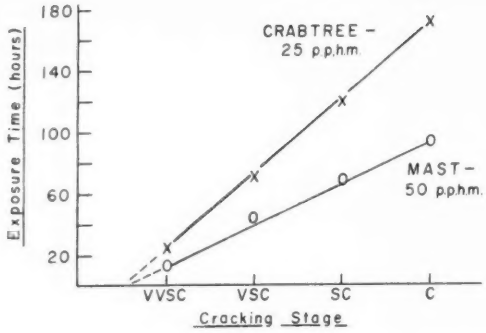


Fig. 3. Rate of ozone cracking using truck tread compound #1. These are static ozone box exposures and represent general curves on the compound made up without wax and with or without chemical antiozonants

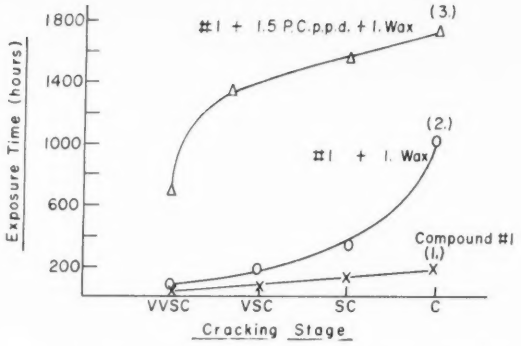


Fig. 4. Improvement in rate of ozone cracking for truck tread compound #1 with the addition of one part wax and the wax plus 1.5 parts P.C.p.p.d. in the Crabtree box containing 25 p.p.h.m. ozone

One general curve was obtained for seven variations (the upper curve) and the lower curve for three variations. The compound variations are reported in Table 3.

It would appear from the data shown in Figures 3 and 5 that the accelerated ozone box exposures largely do not distinguish between the compounding variables used in the work to this point.

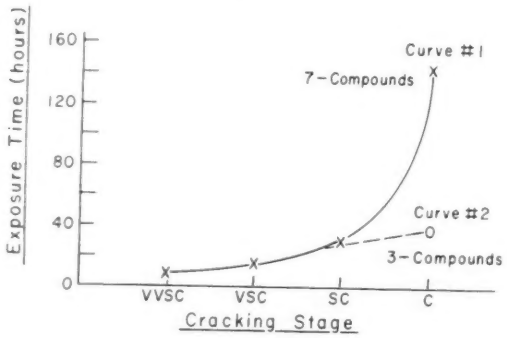


Fig. 5. Rate of ozone cracking for 10 variations of truck tread compound #2 in the Mast ozone box containing 50 p.p.h.m. ozone (see Table 3)

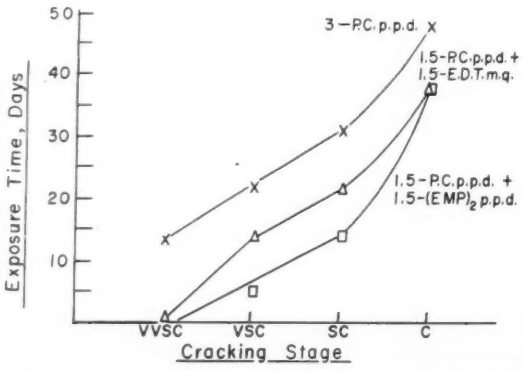


Fig. 6. Effect of antiozonants on the rate of static ozone cracking on truck tread compound #2 exposed to outdoor roof aging at Naugatuck, Conn.

TABLE 3. COMPOUND VARIATIONS FOR FIGURE 5

Curve #1		
	% Antiozonant	% Wax
3	P.C.p.p.d.	—
4	P.C.p.p.d.	—
3	P.C.p.p.d.	0.5
3	P.C.p.p.d.	1.0
1.5	P.C.p.p.d.	—
1.5	P.C.p.p.d. + 1.5 E.D.T.m.q.	—
1.5	P.C.p.p.d. + 1.0 E.D.T.m.q.	0.5
Curve #2		
	% Antiozonant	% Wax
1.5	P.C.p.p.d. + 0.5 $(EMP)_2$ p.p.d.	—
1.5	P.C.p.p.d. + 1.5 $(EMP)_2$ p.p.d.	—
1.5	P.C.p.p.d. + 0.5 $(EMP)_2$ p.p.d.	0.5

Static Outdoor Cracking Tests

Analogous tests were run outdoors at Naugatuck, Conn., on similar bent loop specimens. Figure 6 presents data illustrating the rate of cracking obtained on some of the compounding variations discussed above. At the 3% level, in the absence of wax, P.C.p.p.d. offers greater static protection than any of the other chemicals tested. By adding 1-2% wax it would be possible to extend greatly the effective outdoor static ozone resistance of this compound.

Figure 6 indicates that the natural outdoor exposure test does distinguish between compounding variables which tend to be obscured in the accelerated ozone box tests.

Outdoor Dynamic Ozone Cracking

In contrast to the accelerated ozone chamber tests, the dynamic outdoor tests of truck tread compounds effectively demonstrate that chemical antiozonants impart protection against dynamic ozone cracking, par-

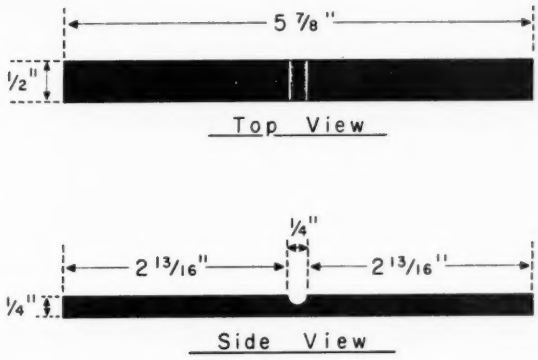


Fig. 7. Molded grooved sample used in the roof flexing test for dynamic outdoor ozone cracking test at Naugatuck, described in text

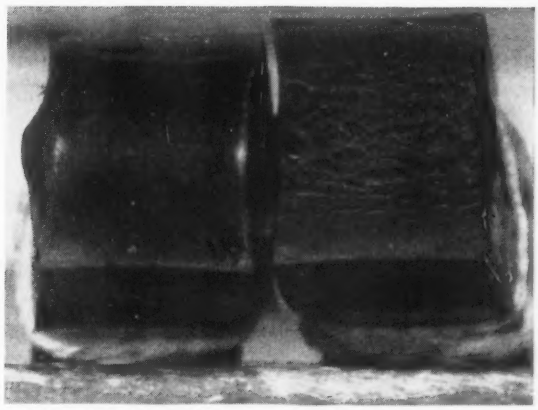


Fig. 8. Pictures of typical samples used for the roof flexing test. These test pieces, as shown in Figure 7, have been bent back to the 78-degree angle specified so that only the interior of the curved surface of the groove is visible: *left*, before test; *right*, at completion of the roof flexing test

ticularly in the absence of wax.

The Naugatuck outdoor dynamic ozone cracking test is a roof flexing test. The test machine was originated by F. L. Holbrook. Its action is basically similar to that of the U. S. bending machine[8]. The angle of bend is ordinarily adjusted to 78 degrees. Flexing is continuous at a rate of 2½ flexes per second, or approximately 200 kilocycles per day. The specimen is a molded grooved sample, as shown in Figure 7. Polished molds are necessary to insure a smooth sample surface. Samples are never precut. Figure 8 shows a sample before and after test.

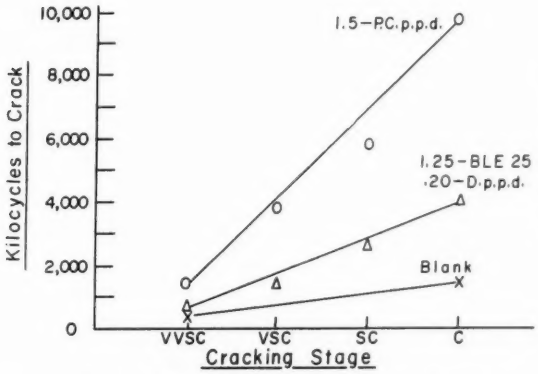


Fig. 9. Rate of dynamic ozone cracking for truck tread compound #1 as observed in outdoor dynamic testing. D.p.p.d. content from Flexamine, see Table 2

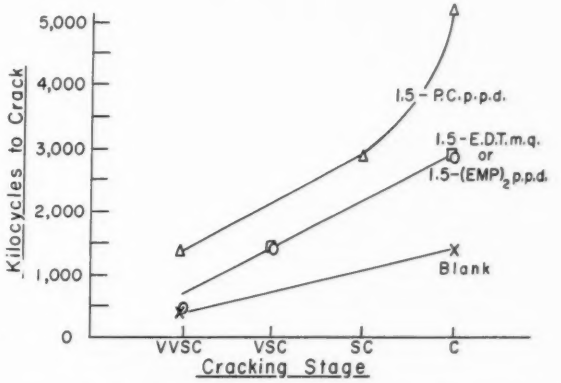


Fig. 10. Comparison of rate of ozone cracking in outdoor dynamic test using truck tread compound #1 protected with 1.5 parts of antiozonant as indicated

Figure 9 shows that 1.5 P.C.p.p.d. strongly enhances the dynamic ozone cracking resistance of truck tread compound #1. The combination of BLE-25 with D.p.p.d[9] provides a lesser degree of dynamic ozone cracking protection. In Figure 10, P.C.p.p.d. is contrasted with E.D.T.m.q. and $(EMP)_2$ p.p.d. These curves demonstrate that P.C.p.p.d. imparts relatively greater protective value.

Since tires develop heat during service and also because it is required that an antiozonant should offer

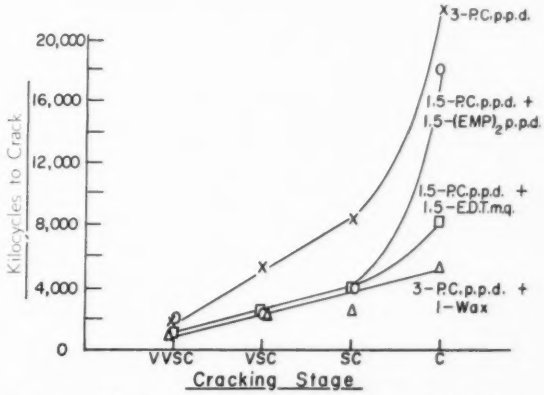


Fig. 11. Effect of several antiozonant combinations on rate of dynamic roof cracking using truck tread compound #2 and with all samples aged for 48 hours at 212° F. in air oven before test

[8]National Rubber Machinery Co., Akron, O.
[9]Flexamine (see Table 2).

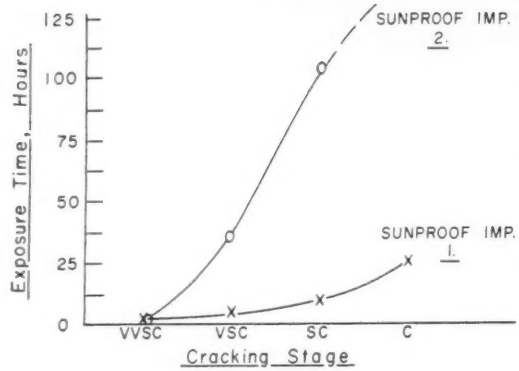


Fig. 12. Comparison of static ozone cracking in Mast box containing 50 p.p.h.m. ozone on sidewall compound #1 protected by 1.7 parts P.C.p.p.d. plus (X) one part of wax *versus* effect of (0) two parts of wax

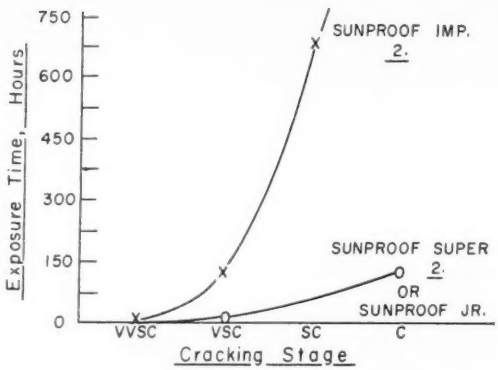


Fig. 13. Comparison of the effect of different waxes on static ozone cracking in Mast box with 50 p.p.h.m. ozone on sidewall compound #1 protected with 1.7 parts P.C.p.p.d.

protection during the natural aging of the tire, it is often desirable to heat age the specimens prior to outdoor dynamic tests. The data reported in Figure 11 show the rate of dynamic cracking for a number of antiozonant variations which were aged for 48 hours at 212° F. The base compound here is truck tread compound #2. It is demonstrated that the high level of dynamic ozone cracking resistance imparted by P.C.p.p.d. is not obtained when P.C.p.p.d. is replaced with $(EMP)_2$ p.p.d. or E.D.T.m.q. on a part-for-part replacement basis. Secondly, it is shown that wax severely damages the dynamic ozone cracking resistance of this tread compound even in the presence of a strong ozone cracking inhibitor.

It is noted that the order of antiozonant effectiveness shown here in the dynamic tests parallels the ratings illustrated in the viscosity degradation test (Figure 1).

At this point it appears that the accelerated ozone chamber tests are misleading indeed for vulcanizates containing no wax.

The sidewall compounds feature the use of wax, and the recipes are detailed in Table 2. The effect of wax level in the Mast box is illustrated in Figure 12, with P.C.p.p.d. as antiozonant. The curves demonstrated that two parts of Sunproof Improved Wax (in sidewall compound #1) produce significantly greater inhibition of ozone cracking than one part of wax although the inception of cracking was similar for both levels of wax.

All waxes do not produce the same effect in the ozone chamber. Figure 13 compares Sunproof Improved with Sunproof Super and Sunproof Jr. at the two-part level. The data show Sunproof Improved to impart significantly greater inhibition of ozone cracking in the accelerated test. All compounds contained 1.7 parts of P.C.p.p.d.

It is also possible to retard the rate of accelerated ozone cracking for a given sidewall compound by increasing the level of chemical antiozonant. Figure 14 demonstrates that increasing the content of P.C.p.p.d. in sidewall compound #2 produces a vast increase in the time required for crack inception in the ozone chamber. This is an SBR compound. The sidewall compound #1, a *Hevea*-SBR blended compound, shows only a small improvement, if any, with increasing content of P.C.p.p.d.

However, if overall rate of cracking is used as the criterion, then the effect of higher antiozonant levels is noteworthy in sidewall compound #1, as shown in Figure 15. Here the time to inception of cracking ("VVS" cracking) is similar for each antiozonant variation. It is noted that the time required to develop "C" cracking is 385 hours for the variations containing 1.92 parts P.C.p.p.d. and 3.0 parts E.D.T.m.q., respectively. Only 147 hours were required in the case of the variation containing 1.92 parts $(EMP)_2$ p.p.d.

Los Angeles Area Tests

By way of contrast, data are now presented showing the rate of cracking developed in natural outdoor exposures at Los Angeles, Calif. during 1958. Figure 16 demonstrates the Los Angeles exposure data for samples analogous to those reported in the accelerated test of Figure 15. If time to the first crack is the criterion, then

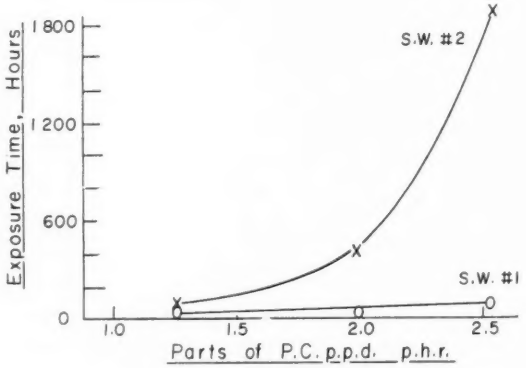


Fig. 14. Effect of P.C.p.p.d. concentration on static ozone cracking of sidewall compounds in Mast box with 50 p.p.h.m. ozone expressed as time to first crack (VVSC)

Fig. 15. Comparison of ozone cracking rates for sidewall compound #1 in static exposure in Mast box with 50 p.p.h.m. ozone protected by anti-ozonants as indicated plus two parts of wax

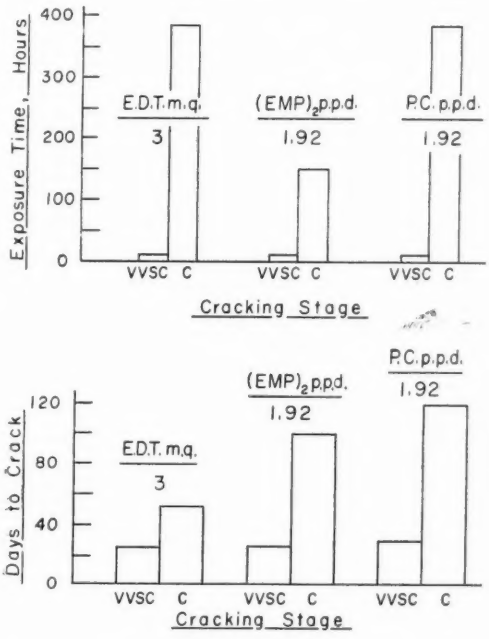


Fig. 16. Effect of antiozonants on rate of ozone cracking of sidewall compound #1 during outdoor static exposure at Los Angeles, expressed in days to first cracks and days to severe cracking

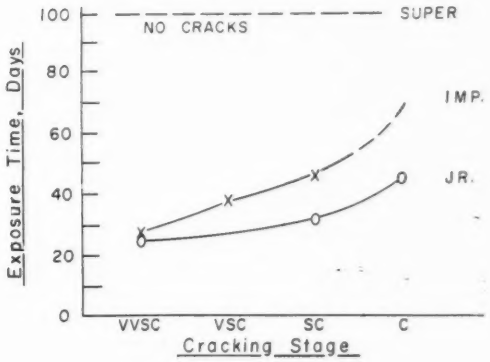
the relative rating of antiozonant effectiveness is similar for both tests. On the other hand if time to reach "C" stage of cracking is the criterion, then the ratings of $(EMP)_2$ p.p.d. and E.D.T.m.q. are reversed. In both tests the P.C.p.p.d. produced the largest relative degree of crack inhibition. It is considered possible that differences in the relative volatility of the $(EMP)_2$ p.p.d. and E.D.T.m.q. might account for this reversal.

In comparing accelerated ozone box exposures with natural static exposures in warm climates, an anomalous result is almost always found when waxes of differing melting points are compared.

Figure 17 shows that Sunproof Super produces greatly superior static ozone cracking resistance in Los Angeles tests, compared to the Sunproof Improved, which, in turn, is somewhat stronger than Sunproof Jr. This result reverses the accelerated ozone box forecast and is entirely due to the higher melting range of the Sunproof Super. The higher ambient temperatures at Los Angeles would favor the Super grade of wax. Waxes of lower melting range tend to be solubilized in the rubber, reducing the protection against ozone. This wax comparison was made at the two-part level.

Dynamic outdoor test data are presented in Figure 18. This graph shows the comparative results for the three commercial antiozonants in sidewall compound #1, using two parts Sunproof Improved Wax and

Fig. 17. Comparison of wax protection during outdoor static exposure on sidewall compound #1 protected by 1.7 parts P.C.p.p.d. plus two parts of the Sunproof wax as indicated. Test made at Los Angeles



several levels of antiozonant. The number of kilocycles to the inception of cracking is the distinguishing characteristic here. It is shown that P.C.p.p.d. imparts greater dynamic ozone-cracking resistance than equivalent amounts of the other antiozonants tested.

Based on the information obtained in the sidewall compounds which contain wax, it would appear that the accelerated ozone box tests predict static ozone protection for chemical antiozonants and waxes, but not necessarily in the same order found in the static outdoor exposures.

The outdoor dynamic test with sidewall compounds orders the chemical antiozonants in the same progression as was found earlier in the truck tread and Naugatuck-Delman tests.

During the period of the work done in Los Angeles, the total oxidant content of the atmosphere in the test area varied as shown in Table 4.[10]

The modern automobile tire is complex in structure and design. Strains are set up during molding, and the tires tend to grow in service, thus increasing existing strains and initiating new strains. Road tests, however,

[10]Total oxidant data obtained from the Air Pollution Control District, County of Los Angeles.

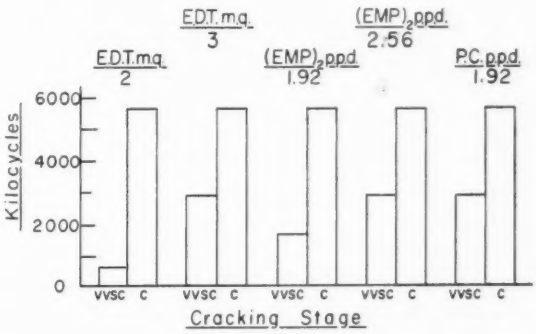


Fig. 18. Effect of antiozonants on dynamic roof cracking in passenger sidewall compounds expressed as kilocycles to first crack and to badly cracked condition

Fig. 19. Weathering wheel for outdoor, accelerated running testing of tires

require relatively long periods of time. A number of American and foreign tire producers employ a weathering wheel to evaluate the effects of weathering and ozone on their products. This is an accelerated test, and a survey of several American manufacturers indicated that testing time was quite reasonable.

The design and basic details of the weathering wheel devised for the Naugatuck tire antiozonant work are shown in Figure 19. Conditions used in the work reported here are reported in Table 5.

Basically this machine is an adaptation of the Gates Rubber Co.[11] weathering wheel. It consists of an automobile chassis and drive. An electric motor drives the tires which, in turn, drive the smooth test wheels.

[11]Private communication from H. F. Tramutt, Gates Rubber Co., Denver, Colo. (Jan. 14, 1958).

TABLE 4. TOTAL OXIDANT DAILY MAXIMA (P.P.H.M.)

1958	Range	Average for Month
March	3–18	6
April	1–27	12
May	3–29	15
June	5–32	14
July	11–40	19
August	9–22	15
September	24–58	24
October	5–64	23

TABLE 5.

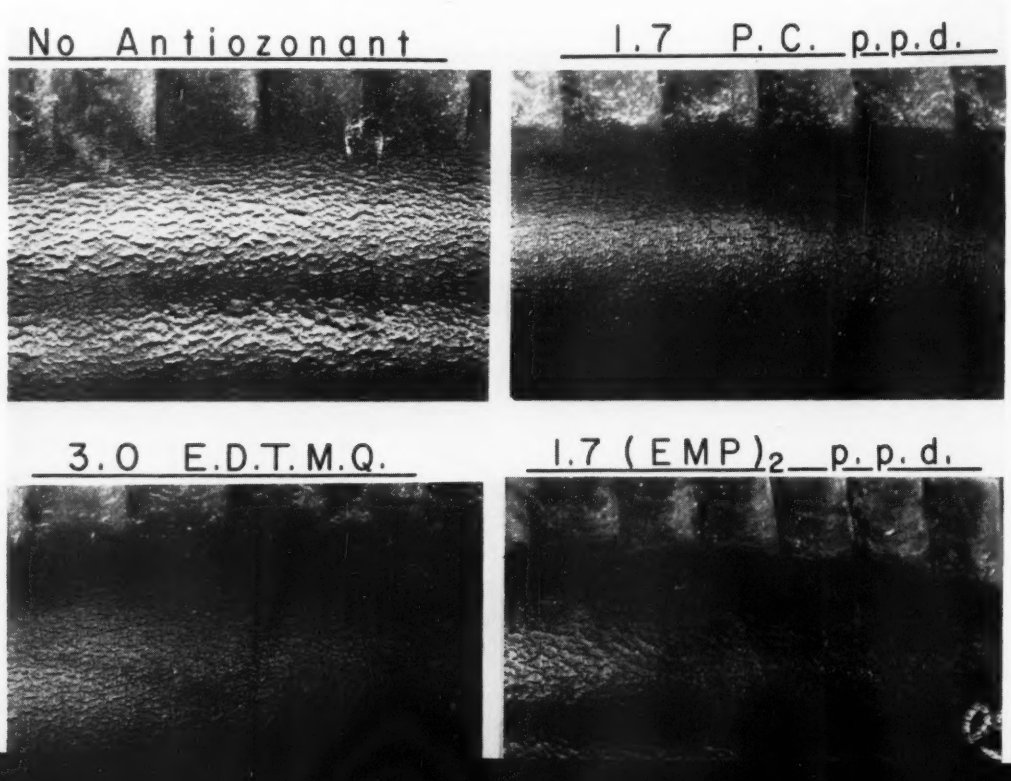
Duration of run	3–8 weeks
Loading	100% T and R Load*
Speed	30 mph.
Inflation	24 psi.
Tire size	8.00–14/4

*Tire & Rim Association, Inc., recommended load.

Loading is effected by adding lead billets to a metal platform welded on the tire end of the chassis. The tires are completely exposed to the elements. Safety considerations require that a wire mesh screen surround the moving parts.

Figure 20 is a composite picture demonstrating the appearance of tire sidewall sections following comple-

Fig. 20. Comparison of effect of antiozonants in composite 8.00-14 size tire run on Los Angeles weathering wheel. Test conditions: static exposure, March-August, 1958; followed by 13,500-mile run on weathering wheel in August-September, 1958



tion of a Los Angeles weathering wheel test. The antiozonant comparison is indicated in the photograph. Multiple-section tires were used. This particular tire was statically exposed at Los Angeles during the period March 20-August 15, 1958. The weathering wheel test was started on the latter date and terminated on September 3, 1958. P.C.p.p.d. is shown to be the strongest antiozonant.

For comparative purposes Figure 21 depicts actual sidewall cracking developed in a comparative test made on a 1957 Mercury operated in the Los Angeles area. The vehicle test was started on March 20, 1958, and terminated on October 29, 1958. Mileage was 12,596. Tire size in both cases was 8.00-14.

The vehicle test confirms the accelerated weathering wheel test. Wheel tests have also been run on tires not preexposed to static weathering. The relative antiozonant ratings in the latter tests were similar to those shown above.

Summary and Conclusions

1. In compounds containing *Hevea* or SBR, but no wax, the degree of effectiveness of chemical ozone cracking inhibitors is largely masked in the accelerated ozone box tests. Antiozonants, however, are effective against normal atmospheric concentrations of ozone in the absence of wax, as shown by outdoor dynamic cracking tests.

2. In conventional tire compounds containing Sunproof Improved Wax the relative effectiveness of chemical ozone cracking inhibitors can be demonstrated in the accelerated ozone box test. The resistance of sidewall compounds containing chemical antiozonants to ozone, as judged by the accelerated static tests, is influenced by the choice of wax and polymer type used. Wax it has been found, however, is detrimental to dynamic ozone cracking.

3. In the presence or absence of wax, the outdoor dynamic ozone cracking test appears to be more definitive as to the degree of effectiveness of the chemical ozone cracking inhibitors tested than the accelerated ozone box test.

4. The choice of wax is important. Reversals between the Los Angeles static exposure and the accelerated ozone box test are to be expected when waxes of low and high melting points are compared.

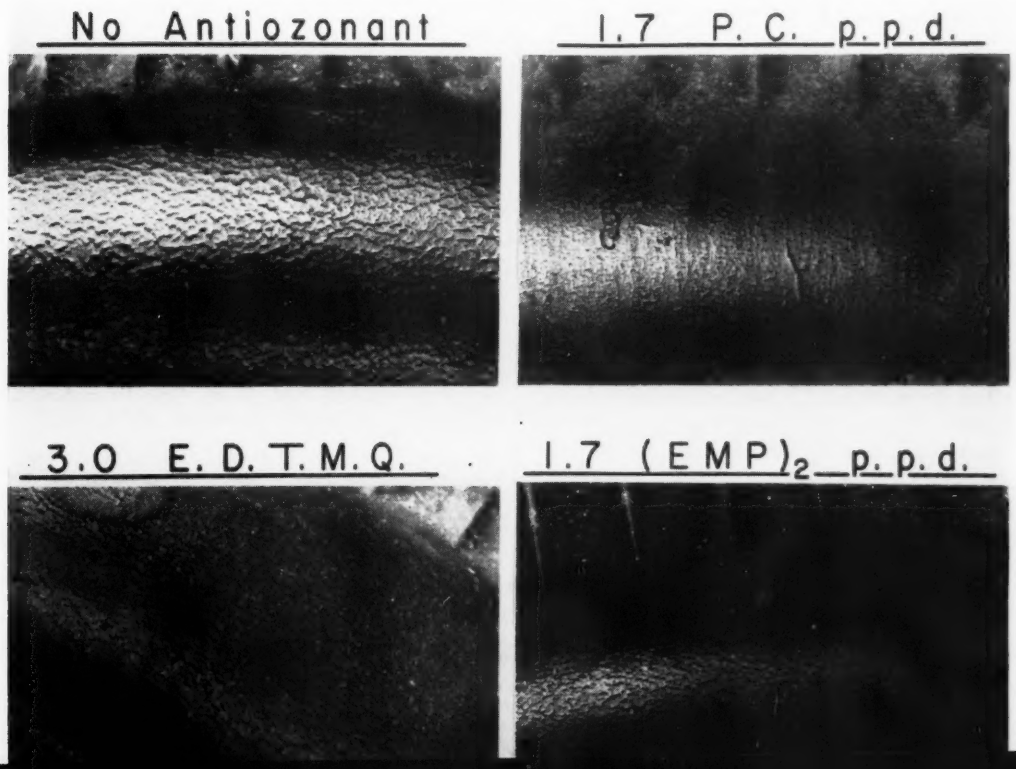
5. The Naugatuck-Delman screening test rates the antiozonants tested in the same order as was actually found in the outdoor dynamic ozone cracking test. The Naugatuck-Delman test is useful in screening new chemicals, but is only effective if used in conjunction with other more definitive tests.

6. An outdoor wheel test has been developed which is shown to correlate well with vehicle tests.

7. The outdoor dynamic cracking test and the weathering wheel test permit the tire compounder to define the ratio of equivalence between chemical antiozonants as well as to provide an insight into the adequacy of his compounds against ozone cracking. Of the laboratory tests used at Naugatuck, the dynamic outdoor test seems most relevant to actual tire performance.

8. Further work is necessary to determine the precision of the last two tests in defining the effect of slight differences in antiozonant loading on rate of ozone cracking.

Fig. 21. Comparison of effect of antiozonants in composite 8.00-14 size tire driven on road test. Tires placed, March 20, 1958; test discontinued, October 29, 1958; mileage, 12,596



Fundamental Control Techniques

II—Control Charts—Part 1

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University College, Rutgers University, New Brunswick, N. J.

DATA which have been collected and classified to form a frequency distribution provide a variation pattern with respect to a size scale and yield information that may often be sufficient to answer questions of practical importance in their bearing on quality/cost problems associated with manufactured items or the processes from which these items came. However, it was pointed out in the article discussing frequency distributions[1] that of necessity they depend on past data, giving essentially a post-mortem insight into what *has* happened in toto as reflected by the product quality profile that the frequency distribution always exhibits. But variations in product quality *with respect to time*, as the items in question were being produced, become completely masked by frequency distribution analysis.

Rather than a post-mortem look, secured by a frequency distribution study of accumulated *product* data, we shall see that for purposes of taking apart a *process* to find out what makes it tick, a much more powerful strategy is available. This is control chart analysis which uses a sequence of relatively small samples and which produces a variation pattern over a time scale. The two strategies are not reversible: a frequency distribution can (and actually often *should*) be made up from the same data that produced the control chart, but rarely will it be possible to make a really meaningful, rational control chart from nothing but the raw data that produced a frequency distribution.

If, then, the major objective of data-gathering effort is to secure and maintain *process control*, inspection procedures leading to control chart analysis will generally be more effective than those which yield *only* frequency distribution data. Accordingly, it will be the purpose of this article to describe and explain some of the basics of control chart strategies.

Shewhart control charts (Grant,[2] page 3 and Chapter IV), which have been so enormously helpful in process control, are of two general types: (A) measurement charts, and (B) attribute charts. We shall discuss these two types of charts separately, but far from fully, because a full discussion would require an article of almost text-book length. Grant[2] and Burr[3] may be con-

[1] RUBBER WORLD, Mar., 1959, p. 869.
[2] "Statistical Quality Control," E. L. Grant. McGraw-Hill Book Co., Inc., New York (1952).
[3] "Engineering Statistics and Quality Control," I. W. Burr. McGraw-Hill (1953).

Control Chart Techniques

This article continues the series on Fundamental Control Techniques by Dr. Wescott which have been featured by RUBBER WORLD, starting in our March, 1959, issue. The purpose of the series is to provide an insight into some of the statistical methods useful in quality control.

This portion covers part of the information on control charts. Charts of two general types will be discussed in this series: measurement charts, which are the subject here, and attribute charts, which will be covered later. These measurement charts give information on quality characteristics that are actually measured, but the purpose of all control charts is to provide a running record of process performance rather than a post-mortem view, such as is given by frequency distributions as discussed in the March installment.

In the first section of the article Dr. Wescott describes the construction and method of use for these average and range charts with some emphasis on the who, when, where, how often, and how much aspects of the sampling procedure to allow satisfactory construction of useful charts.

Following through on the development of control charts, it is shown how the charts can be used to find out whether on not a process is in statistical control, and, if so, how its natural tolerance is related to the blueprint specifications for a product. If the process is operating within statistical control, but does not provide a product within blueprint specifications, alternatives that may be chosen are outlined. An actual case history is used to demonstrate these techniques.

sulted for a really adequate presentation of this important technique.

The two most widely used members of the measurement charts family are the average and range charts, commonly called $\bar{X}$ (read "X-bar") and R charts, or variations of these. The two most widely used members of the attribute charts family are the fraction defective and number of defects per unit charts, commonly called p charts and c charts, respectively, or variations of these.

A. Average and Range Measurement Charts

1. Construction (Data from a Constant Cause System)

Average and range charts would be the charts you would use if the quality characteristic you wanted to study was something that you actually *measured* each time you made an inspection. Thus, if it is desired to control a dimension, a weight, electrical resistance, tensile, temperature, viscosity, hardness, % concentration, time, or any such similar measurable characteristic, X-bar and R charts would be correct charts to keep. There would, however, have to be a separate X-bar and R chart for each characteristic studied—only one kind of measurement at a time can be recorded on these charts. Thus, if it is desired to control an outside diameter *and* a key-way depth on a given piece, a separate X-bar and R chart would have to be maintained for *each* dimension.

GETTING THE DATA. You cannot make a control chart without data. You cannot make a *useful* control chart without *good* data. No control chart—or any other form of statistical study—can ever be any better than the data on which it is based.

Consequently, before you make any control charts in your plant, give some careful thought to a few important preliminary decisions that have to be made before data for the charts are collected. These decisions should be based on practical operating and economic considerations and are concerned with such questions as:

1. What characteristic and operation shall be put under control chart study, and why?
2. What sample size shall be used for charting purposes?
3. How often shall samples be taken and inspected for control chart purposes?
4. What shall be the method of sampling?
5. Who will have the responsibility for doing the sampling inspection and reporting the results?
6. What shall be the method of measurement?
7. How many samples should be taken before the control chart is analyzed and interpreted and action taken?

For control chart purposes we want a sequence of small samples spread out over a time interval rather than one large sample taken and inspected at some particular point in time. The latter method may tell us what *did* happen, but not *how* or *when* it happened; the former tells us what *is* happening, which is the main reason a well-managed control chart is such a powerful tool for keeping a finger on the pulse of a process as it operates—we get a *running picture* of process performance that makes possible (with minimum risk of being wrong) a choice as to whether to leave it alone or take corrective action.

Suppose we decide to make an X-bar and R chart of the OD (outside diameter) of a piston pin at the finish-grind operation that brings it from rough-grind down to final dimension (except possibly for a polish grind that takes off no measurable amount of stock). This piston pin is part of the piston assembly in the compressor unit of a home-use refrigerator. We have had no trouble with this operation or dimension and choose it for charting purposes because we want to demonstrate to our associates in the plant how a controlled process looks on an X-bar and R chart.

We decide that it will be feasible and practical to take samples of five pins about three times per hour. Our patrol inspector will make the periodic inspections, but he will not do so at *exactly* every 20 minutes —such a procedure would be bound to present a psychological hazard for the operator: we want the inspector to average three inspections per hour, but not with such regularity as to tempt the operator!

The inspector will be instructed to take five pins at random from the tote pan containing pins produced since his last visit and to make one random OD reading on each of these pins with a dial indicator that is graduated to read in 0.0001-inch.

Under these procedures we should be able to get reports on about 25 samples of five in each eight-hour shift. We will make our first analysis as soon as 25 such samples have been reported. This will give us a fairly quick control chart and one which has enough data on it for good statistical purposes. (A good rule on this point is: a minimum of 50 individual readings, and preferably 100 or more before making a control chart analysis; 25 samples of five serve this purpose very nicely.)

Table 1 shows the data for the first 25 samples. Notice the heading on Table 1. Always plan your data sheets so that they have a heading that carries adequate identification of the data. Other data sheet forms for X-bar and R data are in use and may be preferred, but the one shown in Table 1 is compact and widely used. Note also that we have not recorded actual measurements: we have recorded only deviations above and below nominal in units of 0.0001-inch. This "coding" arrangement fits in conveniently with the dial-indicator scale markings and gives us simple positive and negative whole numbers to work with.

We use the letter X to represent the variable "diameter" in these data. Then X_1 simply means the diameter reading we get on the *first* pin we measure in each sample; X_2 stands for the diameter of the *second* pin we measure, and so on through X_5. Sample measurements are recorded across a row. Thus, the pins we inspected in our first sample gave us the readings 0.6251, 0.6249, 0.6248, 0.6252, and 0.6250, respectively, and these are recorded on row "Sample No. 1" as 1, —1, —2, 2, 0 since we are setting down only the number of 0.0001-inch above or below the nom-

Table 1 - DATA SHEET FOR $\bar{X}$, R CHART

COMPANY: Midwest Refrigerators, Inc.
PART NAME: Piston-pin, compressor unit piston PART NO.: 6755-B
OPERATION NO.: 22 MACHINE NO.: T-3764 DEPARTMENT NO.: 46
CHARACTERISTIC MEASURED: Outside Diameter
METHOD OF MEASUREMENT: Dial Indicator
SPECIFICATIONS: 0.6250" ± 0.0005" UNIT OF MEASURE: 0.0001"
SAMPLE SIZE: 5 SAMPLING INTERVAL: 3 per hour INSPECTOR:_____

Sample No.	Date Time	Sample Measurements X_1	X_2	X_3	X_4	X_5	$\bar{X}$	R	Notes
	2/11/59								
1	7:40	1	-1	-2	2	0	0	4	
2	7:55	-2	0	-2	2	0	-0.4	4	
3	8:15	0	0	1	-1	3	0.6	4	
4	8:30	1	2	-1	2	-2	0.4	4	
5	8:50	2	1	-1	1	0	0.6	3	
6	9:15	2	-1	2	-1	0	0.4	3	
7	9:35	-2	-1	0	-2	0	-1.0	2	
8	10:00	1	1	0	1	-1	0.4	2	
9	10:15	0	-2	1	-1	4	0.4	6	
10	10:40	-1	-1	0	-2	1	-0.6	3	
11	11:00	1	-1	2	-1	0	0.2	3	
12	11:20	2	2	-1	-1	0	0.4	3	
13	12:15	0	-2	2	-2	0	-0.4	4	
14	12:35	0	-1	1	-1	2	0.2	3	
15	12:50	-3	0	0	0	-1	-0.8	3	
16	1:10	0	-1	0	1	2	0.4	3	
17	1:30	3	1	-3	-2	0	-0.2	6	
18	1:45	-1	-2	-1	-1	0	-1.0	2	
19	2:10	0	0	0	1	1	0.4	1	
20	2:30	0	-5	2	2	0	-0.2	7	
21	2:45	2	-1	1	0	0	0.4	3	
22	3:05	0	0	-3	2	-3	-0.8	5	
23	3:25	3	1	4	-2	-1	1.0	6	
24	3:40	1	-3	0	1	-1	-0.4	4	
25	3:50	-1	0	1	0	1	0.2	2	
					Totals		+0.2	90	

inal of 0.6250-inch.

Having measured and recorded the diameter on each of the five pins in a sample, we then compute and put down for that sample its "average" and "range".

The average, $\bar{X}$, of a sample is simply the total of all readings recorded, divided by the number of readings. Thus, for Sample No. 2, we have $(-2) + 0 + (-2) + 2 + 0$ which totals -2, and this total divided by 5 (five pins in the sample) gives the average $\bar{X} = -0.4$. We carry out these calculations each time a sample of five is inspected, recording our results in the "Average," or $\bar{X}$ column.

The range reading for each sample is simply the numerical difference between the highest and the lowest diameter in the sample. For Sample No. 1, we found one diameter as high as 2-tenths above nominal (and none higher) and one as low as 2-tenths below nominal (and none lower). The range, or number of tenths between these two opposite extremes in the sample is then clearly 4-tenths; so we put down 4 in the range or R column. All R values are positive.

Once the necessary preliminary decisions have been made, "getting the data" for an X-bar and R chart consists of:

(1) Filling out the identification details on the data sheet.
(2) Recording on each row of the data sheet the single measurement made on each piece in the inspection sample.
(3) Calculating for each sample its average, $\bar{X}$, and recording this in the $\bar{X}$ column on the same row with the sample data.
(4) Calculating for each sample its "spread," or range, R, and recording this in the R column on the same row with the sample data.

Let n = number of pieces in a sample (in our piston pin data, n = 5). Then simple formulas for average and range are:

$$\bar{X} = \Sigma X/n \text{ and } R = X_{max.} - X_{min.}$$

where Σ is the capital Greek letter sigma, here used to mean "add the n values of X in the sample."

MAKING THE CHARTS. Now that we have our data, we want to see what the piston-pin process has been trying to tell us about itself through these data over the span of time during their collection. This story will come out vividly when we plot our data in the form of an X-bar and R chart.

A sheet of ordinary rectangular graph paper with rulings printed ten to the inch will be adequate. Make sure that adequate identification details are included in the heading on this paper. In your plant these graph paper forms will generally be printed up with appropriate heading detail ready to be filled in.

It is customary to position the average and range charts as shown in Figure 1. After suitable scales have been set up for sample identification in the horizontal direction and range and average identification in the vertical direction, we plot the 25 values of R and the 25 values of $\bar{X}$ recorded on the data sheet of Table 1. The points should be plotted boldly, so they can be seen, but need not be connected unless it is desired to "dress up" the appearance of the charts, as we have done in Figure 1.

The charts are beginning to take shape—at least we can now visualize how sample average and range varied over this one day's operation. To complete the picture, so as to have *control* charts, we need to add central and control limit lines on both the average and range panels.

Go back to the data sheet and find the total of the 25 values of $\bar{X}$ in the $\bar{X}$ column. Then divide this total by 25 to get the grand average, $\bar{\bar{X}}$, called "X-double-bar." For these data, we find $\bar{\bar{X}} = +0.2/25 = +0.008$. This figure is not only the average of our 25 sample averages; it is also the grand average of all the 125 individual piston-pin diameters that were inspected. It is plotted in the $\bar{X}$ panel of our chart as a solid line and provides the central line on this chart. It pictures the level or overall average performance of the piston-pin finish grind operation during this day's run.

In general, if we have N values of $\bar{X}$, then $\bar{\bar{X}} = \Sigma\bar{X}/N$ when each $\bar{X}$ is based on a constant sample size n.

Similarly, we find the total of the 25 values of R

COMPANY: Midwest Refrigerators, Inc.
PART NAME: Piston-pin, compressor unit piston PART NO: 6755-B
OPERATION NO: 22 MACHINE NO: T-3764 DEPARTMENT NO: 46
CHARACTERISTIC MEASURED: Outside Diameter
METHOD OF MEASUREMENT: Dial Indicator
SPECIFICATIONS: 0.6250"±0.0005" UNIT OF MEASURE: 0.0001"
SAMPLE SIZE: 5 SAMPLING INTERVAL: 3 per hour
INSPECTOR: _____

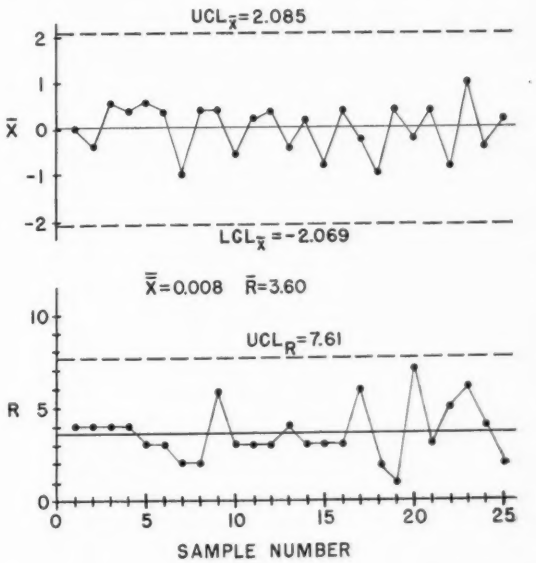


Fig. 1. Completed $\bar{X}$, R measurement control charts derived from the measured data listed in Table I including a typical completed heading and description section

in the R column of the data sheet, divide this total by 25, and call the result $\bar{R}$. For these data, we get $\bar{R} = 90/25 = 3.60$. It is the average range for samples of 5 from this process during this particular day. We plot it as a solid line across the range panel of our chart.

In general, if we have N values of R, then $\bar{R} = \Sigma R/N$.

Note how both the averages and ranges vary about these respective central lines. It is natural and correct to think of these central lines as the target the process was shooting at. We should no more expect the piston-pin finish grind operation to hit this target every time than we would expect that a pair of unbiased dice tossed repeatedly at random should always come up 7 (which, incidentally *is* the target value for a pair of dice!). There are just too many unknown variables operating in both the piston-pin and the dice situation to make such perfection possible. There is bound to be a certain amount of departure from perfection, or variation about an average—we expect this and think nothing of it as long as it appears to be within limits.

But just what do we mean by "within limits"? Here is where the laws of probability step in to take the guess-work out of the problem for us. These laws, which operate just as certainly for a grinding operation as they do for the game of craps, give us simple rules for placing on our charts a pair of lines called

Table 2—FACTORS FOR COMPUTING CONTROL CHART LINES

Number of Observations in Sample, n	Chart for Averages		Chart for Standard Deviations			Chart for Ranges		
	Factors for Control Limits		Factor for Central Line	Factors for Control Limits		Factor for Central Line	Factors for Control Limits	
	A_1	A_2	c_2	B_3	B_4	d_2	D_3	D_4
2	3.760	1.880	0.5642	0	3.267	1.128	0	3.267
3	2.394	1.023	0.7236	0	2.568	1.693	0	2.575
4	1.880	0.729	0.7979	0	2.266	2.059	0	2.282
5	1.596	0.577	0.8407	0	2.089	2.326	0	2.115
6	1.410	0.483	0.8686	0.030	1.970	2.534	0	2.004
7	1.277	0.419	0.8882	0.118	1.882	2.704	0.076	1.924
8	1.175	0.373	0.9027	0.185	1.815	2.847	0.136	1.864
9	1.094	0.337	0.9139	0.239	1.761	2.970	0.184	1.816
10	1.028	0.308	0.9227	0.284	1.716	3.078	0.223	1.777
11	0.973	0.285	0.9300	0.321	1.679	3.173	0.256	1.744
12	0.925	0.266	0.9359	0.354	1.646	3.258	0.284	1.716
13	0.884	0.249	0.9410	0.382	1.618	3.336	0.308	1.692
14	0.848	0.235	0.9453	0.406	1.594	3.407	0.329	1.671
15	0.816	0.223	0.9490	0.428	1.572	3.472	0.348	1.652
16	0.788	0.212	0.9523	0.448	1.552	3.532	0.364	1.636
17	0.762	0.203	0.9551	0.466	1.534	3.588	0.379	1.621
18	0.738	0.194	0.9576	0.482	1.518	3.640	0.392	1.608
19	0.717	0.187	0.9599	0.497	1.503	3.689	0.404	1.596
20	0.697	0.180	0.9619	0.510	1.490	3.735	0.414	1.586
21	0.679	0.173	0.9638	0.523	1.477	3.778	0.425	1.575
22	0.662	0.167	0.9655	0.534	1.466	3.819	0.434	1.566
23	0.647	0.162	0.9670	0.545	1.455	3.858	0.443	1.557
24	0.632	0.157	0.9684	0.555	1.445	3.895	0.452	1.548
25	0.619	0.153	0.9696	0.565	1.435	3.931	0.459	1.541
Over 25	$\frac{3}{\sqrt{n}}$	....	....	*	**	....	....	....

* $1-\frac{3}{\sqrt{2n}}$ ** $1+\frac{3}{\sqrt{2n}}$

Table 2 reprinted with permission from "ASTM Manual on Quality Control of Materials." Copyright 1951 by the American Society for Testing Materials, 1916 Race St., Philadelphia, Pa.

"control limits." The laws say that *if nothing but chance causes are responsible for the variation observed on the chart,* then well over 99% of the points will lie between the control limit lines. To put it another way: if only normal, natural, to-be-expected causes of variation are at work in our grinding operation, then there is less than one chance in a hundred that a random sample of pin diameters will be able to produce an average diameter outside the control limits on the $\overline{X}$ chart or a range outside the control limit on the R chart. Morever, we may expect the variation *between* these control limits to exhibit a random pattern.

Now, "Let's look at the record!"—let's put control limits on our $\overline{X}$ and R charts and see if this grinding operation is behaving as we would expect a "constant cause system" to behave. We will need three numbers called A_2, D_3, D_4 in control chart work.

These numbers change as sample size changes, as may be observed by consulting Table 2. They are derived from the laws of probability governing the extent to which chance can be accepted as an explanation for variation in ranges and averages above and below their respective central lines on these charts. The larger the sample size, the less chance variation there should be; so these factors decrease in magnitude as sample size increases. The lines these factors help locate set limits, called "control limits," appropriate for the sample size being used, and such that a point which plots beyond these limits has a very small probability of getting there by chance alone. When sample size n=5, we find A_2=0.577, D_3=0 and D_4=2.115.

If we use $UCL_{\overline{X}}$ for "upper control limit on averages," $LCL_{\overline{X}}$ for "lower control limit on averages,"

UCL_R for "upper control limit on ranges," and LCL_R for "lower control limit on ranges," the procedure is as follows:

(1) Calculate the product $A_2\overline{R}$, viz., (0.577)(3.60) =2.077. This tells us how much "allowance" we have to give to chance causes as an explanation for the variation in the $\overline{X}$ points about their grand average $\overline{\overline{X}}$ when sample size is 5.

(2) To locate the upper control limit on the $\overline{X}$ chart, add this allowance of 2.077 to the central line value to get

$$UCL_{\overline{X}} = \overline{\overline{X}} + A_2\overline{R} = 0.008 + 2.077 = 2.085$$

It is very unlikely that an $\overline{X}$ value will be greater than $UCL_{\overline{X}} = 2.085$ if only chance causes are responsible for variation in the process.

(3) To locate the lower control limit on the $\overline{X}$ chart, substract the allowance of 2.077 from the central line value to get

$$LCL_{\overline{X}} = \overline{\overline{X}} - A_2\overline{R} = 0.008 - 2.077 = -2.069$$

It is very unlikely that an $\overline{X}$ value will be less than $LCL_{\overline{X}} = -2.069$ if only chance causes are responsible for variation in the process.

(4) Calculate the product $D_4\overline{R}$, viz., (2.115)(3.60) = 7.61 This figure gives us *directly* the upper control limit on range, i.e., $UCL_R = 7.61$. It is very unlikely that a range value in a sample of 5 will be 8 or larger when $\overline{R}$=3.60 if only chance causes are responsible for variation in the process.

(5) Calculate the product $D_3\overline{R}$, viz., (0)(3.60)=0. If $D_3 \neq 0$, the product $D_3\overline{R}$ would give us directly the lower control limit on range, i.e., $LCL_R = D_3\overline{R}$ when $D_3 \neq 0$, and is very unlikely that a range value would be less than the lower control limit if only chance causes are responsible for variation in the process. The sample size would have to be 7 or more for $D_3\overline{R} \neq 0$ (see Table 2); so when sample size is 6 or less (5 in our example) there *is* no lower control limit on the range chart. In other words, in our example, a range of zero is not an *exceptional* value — it could be explained as a chance event.

(6) Plot the values calculated in (2) and (3) as horizontal broken lines across the $\overline{X}$ panel of the chart.

(7) Plot the values calculated in (4) and (5) as horizontal broken lines across the R panel of the chart, *except* that for n=5, D_3=0, so in our example, we do not have a lower control limit on the range chart.

When steps (1)-(7) are finished, we will have the completed X-bar and R charts shown here as Figure 1.

INTERPRETATION. An X-bar and R chart is a graphical test of the assumption that all the variation in a process is coming from a host of small causes operating in a chance manner. When the charts look like our completed Figure 1, this assumption is sustained—there is no evidence of the presence of any "assignable causes" or erratic performance. We say the process is operating in a state of "statistical control," which generally means, "Leave this process alone. It will be either impossible or unprofitable to try to locate the causes that produce this kind of variation." If no basic changes are made in the operation of such a process, we can predict that it will continue to behave in this same, dependable manner as long as no forces enter the process to change the cause system, and we speak of such a system as a "constant cause system."

But "statistical control" is not enough. It is fine to know that a process has this dependable sort of stability, but what if its level is too far above or below the blueprint nominal? Or what if the variability about the process level is so great that even when the level (or average) is near nominal, the process still makes too many pieces outside one or both tolerance limits? Finally, what if the stable state of control is such that *both* the level *and* the variability are such as to make sizable amounts of product outside specifications?

In such cases the "dependability" guaranteed by the state of control found on the charts is of a negative sort; we can *depend* on such a process to go right along every day making unacceptable product! It will be absolutely necessary in such a case to make really *fundamental* changes in the process—just "tinkering" with it will do no good and may make matters worse.

It thus appears that as soon as we have managed to get a process to exhibit the kind of stability we found on the charts in our completed Figure 1, the next thing to find out is whether or not this statistical control is also *satisfactory* control. We are now asking, "Will this *process*, which is now operating in a dependable, predictable manner, make individual pieces of *product* that meet specifications?"

The simplest way to answer this question from an X-bar and R chart that shows a process operating in control is to get another number, called d_2, from the tables previously consulted for the A_2, D_3, and D_4 numbers. This d_2 number also changes with sample size, and for n=5, it will be found that d_2=2.326. The reason we have to do this is that the control limits on the X-bar and R charts set limits on the to-be-expected variation for *only* sample *averages* and sample *ranges*—they tell us *nothing directly* about the limits within which *individual* piston-pin diameters are varying. *Never* compare control limits on an X-bar or R chart with blueprint specifications.

The correct procedure is to calculate a number called "standard deviation of X," denoted by the Greek letter σ_X (read "sigma of X"), and found by the formula $\sigma_X = \overline{R}/d_2$. Evidently it takes d_2 units of σ_X to make one unit of $\overline{R}$, because $\overline{R} = d_2\sigma_X$. There is nothing mystifying about this. Just as 1 meter = 3.28 feet, so $1\ \overline{R} = d_2\sigma_X$, whence $\sigma_X = \overline{R}/d_2$. Both $\overline{R}$ and σ_X are statistical yardsticks for measuring dispersion, just as the meter and the foot are two different yardsticks for measuring length.

Now it happens (for reasons that need not concern us here) that σ_X is the *preferred* yardstick for measuring dispersion when the object is to step off limits within which all, or very nearly all, of the *individual* values in a given cause system can be expected to lie. In our example we actually inspected only 125 individual piston-pin diameters. These 125 values produced 25 sample averages and 25 sample ranges which exhibited only chance variation on the $\overline{X}$,R charts in Figure 1. So we have a stable *process* (cause system), and a fair question is: "What limits may we predict for the *uninspected* piston-pin diameters?" We made many more than 125 of these piston pins, but we checked only 125 of them. What limits can we safely assert contain all, or very nearly all, of the total number of piston-pin diameters produced on this day?

The σ_X yardstick is used for stepping off the limits within which all, or very nearly all, individual piston-pin diameters will be contained as long as the X-bar and R charts stay in control at or near the $\overline{\overline{X}}$ and $\overline{R}$ values found for Figure 1. Under such conditions the laws of chance are operating in such a way that we can be morally certain the process will seldom turn out an individual pin having a diameter *larger* than $\overline{\overline{X}}+3\sigma_X$ or *smaller* than $\overline{\overline{X}}-3\sigma_X$

For our data we have

$$\overline{\overline{X}} = 0.008;\ \overline{R} = 3.60;\ d_2 = 2.326.$$

Then $\sigma_X = (3.60)/2.326 = 1.548$; so $3\sigma_X = 4.644$.

Hence $\overline{\overline{X}} + 3\sigma_X = 0.008 + 4.644 = 4.65$

$$\overline{\overline{X}} - 3\sigma_X = 0.008 - 4.644 = -4.64$$

Better than 99% of all piston-pin diameters made during the day we made the charts in Figure 1 fell between these two limits. What is more important: we can expect better than 99% of all piston-pin diameters made on any *other* day to fall between these limits as long as the X-bar and R charts continue to stay in this state of control! These limits represent a good estimate of what is called the "natural tolerance" of the process.

Since, in coded units, the upper specification limit is USL=5 and the lower specification limit is LSL= −5, the comparison is: $\overline{\overline{X}}+3\sigma_X$ against USL and $\overline{\overline{X}}-3\sigma_X$ against LSL, i.e., *natural* vs. *blueprint tolerance.*

We know the finish grind operation on these pins is operating in statistical control.

Is the control also satisfactory—are we making pins that meet specifications? Is natural tolerance *within* print tolerance? The answer is obviously "Yes."

Would it be useful to continue these charts by extending the central and control limit lines to cover future production, plotting inspection results against these standards, and taking corrective action to get the process back on this highway each time a point went outside a control limit? You may supply your own answer, but companies that *are* doing this sort of thing are getting *greater quantity, better quality,* and *lower costs* as a result! At any rate, in Section 2, we shall explore this matter of using a control chart to help *maintain* control once we have finished using it to help *attain* control of a process.

TABLE 3

X	Freq
5	0
4	2
3	3
2	17
1	22
0	36
−1	26
−2	13
−3	5
−4	0
−5	1
	125

Just incidentally, you may find it illuminating to tally up the 125 individual X values so as to form the frequency distribution pattern which these observations generated in the course of this one day's operation. You will get the result shown in Table 3. The corresponding histogram will be convincing evidence that the OD dimension is governed by the normal probability law in this operation as it ran on the day these data were collected. This distribution, *together* with the X-bar and R charts, gives a powerful insight into the stability of this process and its underlying variation pattern, both with respect to time (for process control purposes) and with respect to size (for process capability and product conformance to specifications). With information like this about a process we can make very positive assertions about the *un*inspected items, and we are in a position to catch and correct promptly any assignable causes of departure from these patterns.

2. Using an Average and Range Chart for Process Control

Now that we have seen what an X-bar and R chart looks like for data from a constant cause system and have learned something about making and interpreting such a chart, we are ready to consider how these charts are used for establishing and maintaining process control of a measurable characteristic.

It is very unlikely that the first time an X-bar and R chart is made for a process never before charted it will turn out to show the satisfactory control we found for the piston-pin finish-grind operation. In fact, it is very unlikely that an *initial* X-bar and R chart on a process will even show *control.* Usually there will be evidence of assignable causes present in the process. Points are likely to be outside control limits on either the X-bar or the R chart, or on *both* charts. This simply means that the variability in the process is *not* coming entirely from a large number of small, independent causes operating in a chance manner. One or more "assignable causes" of excessive variability drifts in and out of the operation from time to time to upset the normal, natural performance of which the process is capable.

It is the *first* responsibility of the quality control engineer to use his charts, his knowledge of the process, and all the help and cooperation he can get from the persons actually running the job to find out what the process capability really is. "What is the *best* natural tolerance this process can hold under existing operating conditions?" This is the first and most important question to answer. Never mind blueprint specifications—the *process* doesn't give a hoot about specifications! But the process *does* know what its natural *capabilities* are. Concern yourself first with letting the process tell you its story on this matter through the control charts. True, what you want is acceptable product, but it is the *process* that makes the product, not the specifications. So keep working on the *process* and watching the control charts as changes and improvements in the operation take place.

THE EXPLORATORY STAGE. This phase of control chart work may be called the "exploratory stage." During this stage the procedure is generally something like the following:

1. Plot 20-30 points on an X-bar and R chart from sample inspections based on the process just as it has been operating. Even some recent past data from the files would do for this step if necessary. Complete the chart by calculating and plotting central and control limit lines.
2. If, as is generally true, the chart shows lack of control, or a process level too high (or too low), or a spread that is too wide, or any other unusual or adverse conditions, work with the people closest to this job to get some corrective action taken. Make one or more changes in the operation—such things as sharpening a tool, tightening a bearing or cross-slide, changing the sequence or speed of operation, making a fixture or jig change—these, and other corrective actions that will be suggested by a knowledge of the process, represent changes in the underlying cause system that makes the process vary in its performance.
3. Following each process change, make a new set of 20-30 plottings and calculate and plot new central and control limits for this set of points and study the resulting picture for clues as to further process adjustments.
4. Repeat this cycle as often as may be necessary, i.e., get the picture, through the charts, of what is going on; if it isn't a flattering picture, make adjustments in the process and get a *new* picture reflecting the effect of these adjustments.

Managing this very fundamental phase of control chart operation quite obviously calls for team work. It is absolutely essential that corrective actions of various sorts be taken to change one or more of the operating conditions if improvement is to occur. The control chart will *correct nothing*—it simply shows in a devastatingly impartial way *what is happening!* If you don't like what you see, don't blame the control chart—it will go right on faithfully reporting the existence of these unhappy conditions. You might as well blame your score card for a poor showing on the golf course! To improve the score card, you have to improve the game, whether the "game" be golf or a manufacturing process. This calls for corrective action, and corrective action requires teamwork among operator, supervisor, foreman, inspector, and quality control. With good teamwork applied to the job, using the charts as a *guide to action,* you will eventually succeed in getting the process to report through the charts what its best capabilities are under operating conditions currently available to you.

NATURAL TOLERANCE — IN OR OUT OF SPECIFICATIONS? Once you have succeeded in getting a process to stay in control on both average and range over 20-30 plottings, and once the natural tolerance associated with this state of control is as good as you can get for the money you can afford to spend on the process, then you have completed the exploratory stage because you will then know what is the best performance you can expect of the process. It may take anywhere from a week to more than a year to complete this goal because you must know what natural tolerance a process can hold before you can possibly know in any *really* practical sense how to control the quality *and* the cost of the product the process is making.

Completion of the exploratory stage must *always* bring a process to one or the other of two states, viz.:

(1) The natural tolerance of the process fails to meet existing specification requirements.
(2) The natural tolerance of the process meets existing specification requirements.

Of course, in case (1), natural tolerance may *just barely* meet *or just barely* exceed existing specs. But either of these states belongs in (1) because they represent a state of "tight" control, and tight control is, generally speaking, not what we want satisfactory control to mean.

NATURAL TOLERANCE OUT OF SPECIFICATIONS. In case (1), there are several courses, as follows:

(a) Change the specifications. It may not be possible to do so, but at least the request for a print change will now be supported by some very convincing, unbiased, *factual* evidence. The chances are the request will be given respectful consideration if properly presented.
(b) Make *fundamental* process changes such as a shutdown and complete overhaul or the purchase of completely new equipment. Obviously this is a management decision. But management will have the cold logic of *facts* on which to base such decisions.
(c) Continue the operation at the best performance possible and institute (or continue!) a 100% sorting operation to pick out the good pieces from production. This, again, is a management decision. If it is chosen, and if control at the established natural tolerance is maintained, it will be possible to predict quite accurately what proportion of total production will be outside blueprint specifications.

(d) If specs cannot be changed, if overhaul or replacement is ruled out, if 100% sorting is excessively expensive (or impossible), there remains only one other solution: stop trying to make the stuff! After all, if you *have* to make an unacceptable product, the sensible thing to do is to refuse to try to make it at all.

When good, honest, continued engineering, production, and statistical effort has brought a process to the point where the control chart evidence clearly says, "This *is* the natural tolerance of the process; this *is* its optimum capabilities under existing circumstances, but its best is not good enough to meet existing quality/cost requirements," then one or the other of the four courses above *must* be chosen. Beating the desk and getting tough won't help. You might as well insist that a pair of ordinary dice roll out the sum 15 for you! If 15 is your point, you'll never make it with the spots available on an ordinary pair of dice no matter how loudly you yell! But you *first* have to find out what spots you actually *have* on your dice before you can say whether or not you can roll a 15 with them! That is what the exploratory stage in control chart operation is concerned with: finding out what the capabilities of the process are, finding out, if you please, what points you *can* roll with the process *you have* when held in control under optimum existing operating conditions.

NATURAL TOLERANCES WITHIN SPECIFICATIONS. Suppose, however, that you find the process in state (2) at the end of the exploratory period, i.e., the process has shown it can perform in control with a natural tolerance that satisfactorily meets specification requirements. Then what?

If this is the situation, we are ready to move into the second stage of control chart operation. In this stage we shift our attention and effort away from *attaining control of the process* and focus it on the business of *maintaining control of the product.* This is accomplished by setting up and using control charts in a somewhat different way than was done during the exploratory stage. Instead of first plotting a run of inspection results and then calculating central and control limit lines to see where we are, or to see if we are any better than we *were,* our procedure now is to set up a *blank* control chart based on suitably chosen standard values for central and control limit lines, and then plot inspection results against these standards to see if the process is staying on the highway it has *previously* alleged it was capable of following.

A Case History Example

It will help at this point to consider a case history typical of just the way these ideas have been used in industry. This example will illustrate the procedure discussed under the exploratory stage part of this paper and will serve nicely as a background for further discussion of the second, or "maintaining control under standard values" stage.

The study concerns a screw machine forming operation. This is one stage in the manufacture of a cylindrical roller bearing whose horizontal cross-section resembles an ordinary household rolling pin. Stock in the form of a cylindrical rod is fed through the machine which automatically stations the rod for a forming operation on the rotating stock that cuts a shoulder on two adjacent rollers. When the shoulder has been cut to the proper depth by the #1 cutter, the #2 cutter then comes in from the opposite side and separates the rollers. (See Figure 2.)

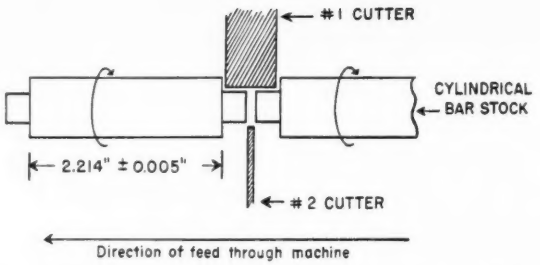


Fig. 2. Operation of automatic screw machine making roller bearings. Cylindrical bar stock is positioned and rotated by machine when fed from the right. Use of control charts to improve control of this operation is detailed in this article

Before this process was brought under control chart operation, *all* rollers were sorted for assembly. Rollers considerably out of specs in either direction could be successfully assembled provided all rollers that went into an assembly were the same length. Measurements were made by a spring gage, and sorting for selective assembly was a regular part of this segment of plant operation. About once every year all leftover, mismatched rollers were thrown out as scrap, and a fresh start was made.

The critical dimension was the shoulder-to-shoulder length on a roller, and specifications called for this length to be 2.214 ± 0.005-inch. Figure 3 shows the X-bar and R charts for three different periods in the exploratory stage of this problem. A heading carrying complete identification details has been omitted for lack of space. The charts show the data coded to the nominal of 2.214 inches as zero and with vertical scales in units of 0.001-inch. Sample size was 5, and the process was inspected for control charting on an average of once each half hour.

Period 1 shows the process operating in statistical control with the exception of one point on the average chart which is just barely below the LCL. Here, then, is a process in which all the variation appears to come from a constant cause system. We can predict that if no changes are made in present operating procedures, roller lengths will *average* pretty close to 9.5 in the coded units used on the charts, or an actual *average* length of 2.2235 inches—over 0.004-inch *longer* on the average than the upper *blueprint specification* limit for an *individual* roller.

But this is not all! A process that shows a state of control as stable as appears to exist in the Period 1 panel has a natural tolerance. Since $n=5$, $\bar{R}=8.3$, and $d_2=2.326$, we find $\sigma_{\bar{x}}=\bar{R}/d_2=(8.3)/(2.326)=3.568$;

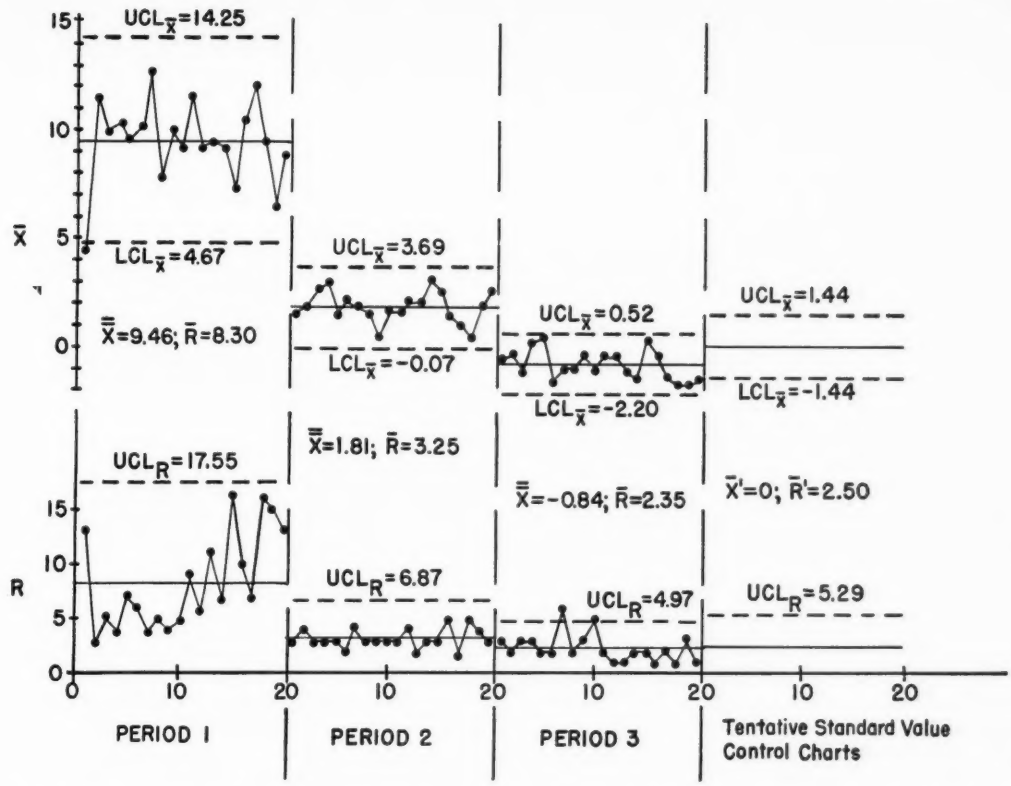


Fig. 3. Series of X, R charts for case history on roller bearings. Period 1 indicates operation at start of study. Period 2 shows results of first alterations to operation. Period 3 shows slight over-compensation in machine control. Final chart indicates expected effective limits for continuing control of product

so $3\sigma_{\bar{X}}$=10.70. With $\bar{\bar{X}}$=9.46, this gives $\bar{\bar{X}}+3\sigma_{\bar{X}}$=9.46 +10.70=20.16; $\bar{\bar{X}}-3\sigma_{\bar{X}}$=9.46—10.70= —1.24. We may therefore estimate the natural tolerance of the process to run from about —1.24 to about 20.16 as against print tolerance from —5 to 5.

We have here good *statistical* control, but very *far* from *satisfactory* control. The process level is too high ($\bar{\bar{X}}$=9.46 vs. a desired nominal of zero) and the dispersion or variation in individual roller lengths is too great (20.16+1.24=21.40 vs. total print tolerance of 10)! The challenge here is not to get *control*—we *have* that—but to get the control to be more satisfactory.

Period 2 shows the X-bar and R charts for a run of 20 points after adjustments and repairs were made on the feeder mechanism. Again, we have good control, with definite improvement in level ($\bar{\bar{X}}$) and variability as measured by $\bar{R}$. We find, with n=5, $\bar{R}$=3.25, d_2=2.326, that $\sigma_{\bar{X}}=(3.25)/(2.326)=1.40$. So $3\sigma_{\bar{X}}$ =4.20, and

$$\bar{\bar{X}} + 3\sigma_{\bar{X}} = 1.81 + 4.20 = 6.01 \text{ vs. USL} = 5$$

$$\bar{\bar{X}} - 3\sigma_{\bar{X}} = 1.81 - 4.20 = -2.39 \text{ vs. LSL} = -5.$$

Total variability for the process in Period 2 is 6.01 +2.39=8.40, which compares very comfortably with total print spread of 10. It remains only to get the process centered closer to nominal.

Period 3 represents another run of 20 points after further adjustments were made on the feeder mechanism. Process level has now been over-corrected, but there is a further reduction in average range. Although there are two ranges beyond UCL_R, we now know enough about controlling this process to consider the exploratory stage completed and to adopt standard values for maintaining control of product on future production.

The final panel in Figure 3 shows a blank control chart blocking out a highway for this process over the next 20 inspections to be made. Central and control limit lines on this blank chart show one possible set of tentative standards. We have, in effect, said, "Our previous experience with control chart operation of this process leads us to believe we can keep it operating in control about a standard process level of $\bar{X}'$=0 with an average range in samples of 5 of $\bar{R}'$=2.50." This will give us control limits of $UCL_{\bar{X}}$=1.44, $LCL_{\bar{X}}$ = —1.44, and UCL_R=5.29. If we can maintain control within these standards, natural tolerance will extend from —3.20 to 3.20, as against a print tolerance of —5 to 5.

Standard Value Operation

There is, of course, a sense of arbitrariness about the chart thus set up for the next run of points. But

the choice of $\overline{X}'=0$ and $\overline{R}'=2.50$ is not just picked out of the air either; we chose these standards because we have the strong support of previous control chart evidence *plus* the weight of all we have learned about this job in getting it to attain a satisfactory natural tolerance. Whenever we have brought a process to a point where we are ready to try operating it on standard values, we

(1) choose standards that are realistic in terms of what we have learned about the process and in terms of what our control chart records show the process can be expected to do, and
(2) regard any standards chosen as tentative in the sense that they will be subject to review and revision as future experience develops.

Under standard value operation, our efforts will be directed, not toward making further adjustments in the process, but toward *maintaining control* against the standards chosen. We plot the points against these standards with the assurance that as long as averages and ranges stay on this highway, individual pieces of product will meet specification requirements. No inspection beyond that needed to keep the charts is any longer necessary; sorting and selective assembly of rollers is out, and the annual scrap-pile housecleaning formerly needed can be completely eliminated. What is more, we can even change the pace for keeping the charts: instead of a sample every half-hour, we can shift to one sample every hour, and perhaps eventually one sample every two hours. The charts become a trustworthy guide for action, telling us to leave the process alone as long as points fall within the control band and to take immediate corrective action to locate and remove any assignable causes responsible for pushing a point beyond one of these control limits or for starting any trends that, left unchecked, might lead to poor quality production. Thus, control charts, such as these, that reflect the natural capability of a process, give us a powerful and sensitive tool for keeping real finger-tip control of a process to insure the delivery of a steady flow of acceptable product at minimum cost.

Other Control Chart Problems

In Section A-1 and A-2 of this article we have had time only for the bare essentials. Several other topics in the X-bar and R chart field deserve and will need your attention as you get better acquainted, through use, with these charts. Foremost of these is the question of how to put under control chart study a multiple component process. Examples of this are: multiple spindle machines, multiple cavity molds, continuous processes such as plating and galvanizing, paper-making, etc. The thing to avoid here is a sampling procedure that takes readings "across the process" and then proceeds to use these as though they were random samples from a *single* potential cause system. Grant[2] (Chapter VII) and Burr[3] (pages 275-280) cover this matter and provide further pertinent references on it.

Another matter you will want to know about is that of "modified limits." When the natural tolerance of a process is very much less than blueprint tolerance, it is possible to set up X-bar and R charts that take advantage of this extra "elbow room" by relaxing the requirement that averages must be held within the UCL and LCL limits we have been using in this paper, and, instead, permit the process level to vary over a wider interval as long as range stays in control. Grant[2] (pages 189-192) and Burr[3] (pages 271-274) cover this matter adequately.

One other topic you will probably want to investigate is that of constructing and using an average and range chart for a process that has some known element in it such as toolwear, that always causes averages to follow a trend pattern of some sort across the chart. In such a case a horizontal central line and horizontal control limits on the average chart are quite useless and unrealistic. What we want instead of a central line is one that shows the general trend of the averages as the tool wears, and we want control limits about this trend line in place of horizontal control limits. The objectives in such a chart are

(1) to establish control on averages that takes account of tool wear, and
(2) to find how long the process can be operated between resettings so as to get the maximum of useful wear from the tool without making out of tolerance product.

Grant[2] (pages 121-122) and Burr[3] (pages 267-271) will give you some ideas about this sort of control chart problem.

Need New Fluid Sealing Materials

A study, "Fluid Sealing in Extreme Environments," by A. A. LePera, WADC, was presented at the SAE national aeronautic meeting, New York, N. Y., March 31-April 3. The paper discusses the elastomers available for seals, and the related design criteria for various fluid systems and their respective environments. It is shown that properly designed seals fabricated from the fluororubbers offer a possible solution to many of the problems also described.

As system temperatures pass 600° F. and climb toward 1000° F., it is quite apparent that the available fluororubbers will no longer be adequate for sealing applications. Attempts to meet these requirements with metallic seals, however, have been unsuccessful to date. The ultimate solution to sealing problems existing in extremely high-temperature systems can probably be accomplished only through a major breakthrough in polymer technology, or through the development of elastomeric-inorganic materials fabricated from a composite of heat-resistant materials.

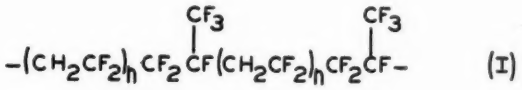
Both of these approaches will require the continued cooperation of polymer chemists, physicists, and engineers engaged in research of new materials.

Dithiol Curing Agents for "Viton"[1] A Fluoroelastomer[2]

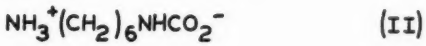
By J. F. SMITH

Elastomer Chemicals Department, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

"VITON" A is a copolymer of vinylidene fluoride and hexafluoropropylene designed for maximum thermal and chemical stability consistent with good elastomeric properties. Its structure, consisting of alternating methylene and difluoromethylene groups interspersed with very short, branched perfluorocarbon chains (I), is very resistant to chemical attack. This property, while valuable in the cross-linked, molded elastomer, makes the problem of cross-linking the gum stock difficult.



(I)



(II)

With the exception of stocks containing peroxide for specialty uses and some experimental cures with high energy radiation, "Viton" A is normally cured with amines and their derivatives. Aliphatic diamines like hexamethylene diamine or their blocked derivatives like the inner carbamate (II) of hexamethylenediamine ("Diak" No. 1)[3] are widely used. All known curing systems are very slow to develop optimum properties even at high (200° C.) temperatures.

The generally recommended procedure is to formulate the elastomer with curing agent and fillers on conventional processing equipment, then to mold the required articles in a press using a curing cycle of one hour at 150° C. The purpose of this press cure is to develop sufficient cross-links in the sample to prevent sponging through release of trapped air during the early stages of the subsequent oven cure. Optimum properties are then developed by heating the partially cured samples in an air oven at a temperature of 200° C. for a period of 15 to 24 hours.

In addition to diamines, it is now known that mono-amines will serve as cross-linking agents for "Viton" A.[4] Mono-amines, however, are slow to cure and require high press temperatures (up to 200° C.) in order to obtain a sufficiently well-developed state of cure to prevent sponging during the subsequent oven-curing cycle. There is some evidence that mono-amines cross-link "Viton" A by developing double bonds in the polymer chains; cross-links are formed by mutual reaction at these double bonds without further involvement of the amines. It has now been shown that dithiols will react very rapidly with double bonds developed in "Viton" by treatment with amines, especially *tert.*-amines, to form cross-links

[1]Registered trade mark of E. I. du Pont de Nemours & Co., Inc.

[2]Contribution No. 86 from Du Pont Elastomer Chemicals Laboratory.

[3]E. I. du Pont de Nemours & Co., Inc.

[4]R. G. Spain, "Behavior of Some Elastomers in Petroleum-Based Fluids at Elevated Temperatures." Division of Rubber Chemistry, ACS, Meeting, Cincinnati, O., May 15, 1958.

The Author

John F. Smith, research chemist, elastomer chemicals department, E. I. du Pont de Nemours & Co., Inc., received his B.Sc. and Ph.D. from the Royal College of Science, London, England. He is a native of London.

Mr. Smith started his career in the rubber industry with Imperial Chemical Industries, Ltd., Manchester, England, in 1951. He next spent some time in Vancouver, Canada, in the pulp and paper industry as a chemical consultant carrying out new methods of pulping and of hardboard manufacture with the British Columbia Research Council. In 1954 he returned to elastomer chemicals research by joining Du Pont where he has been engaged in studies on dyes, whitening agents, isocyanates, and fluorinated monomers, polymers, and elastomers.

Mr. Smith is a member of the American Chemical Society and its Division of Rubber Chemistry. He is also a member of the Wilmington Organic Chemists Club.

J. F. Smith

Dithiol Curing Agents for "Viton" A Fluoroelastomer

Cures in current use for "Viton" elastomer tend to be somewhat slow to develop optimum properties even at temperatures as high as 200° C. With the discovery that mono-amines would serve as cross-linking agents for "Viton," a study was instituted to evaluate more fully the amine cure system. It was also found that dithiols with the amines would produce cross-linking and, especially with *tert.* amines, would do so at lower press temperatures and at a faster rate.

This paper presents the results of the study to evaluate this new curing system for "Viton" A. It was found that a three-part combination is required: the dithiol cross-linking agent, an amine cocuring agent, and an acid acceptor. Each of these three agents and their function in the curing system are discussed in some detail. The dithiols used may be aliphatic or aromatic; the tertiary amines must be strong aliphatic bases; and magnesium oxide proved to be the most satisfactory acid acceptor.

This curing system provides compounds with good scorch resistance, high tensile strength, and low compression set, but at some loss of resistance to aging at temperatures of 550° F., when compared with the conventional hexamethylene diamine carbamate cure.

TABLE 1. EFFECT OF AMINE COCURING AGENT ON DITHIOL CURE

	A	B	C	D	E	F	G	H
"Viton" A	100	100	100	100	100	100	100	100
MT black	18	18	18	18	18	18	18	18
MgO	15	15	15	15	15	15	15	15
N,N-Dimethyldodecylamine	—	0.2	0.3	0.5	—	—	—	—
Dicyclohexylamine	—	—	—	—	1	—	—	—
Cyclohexylamine	—	—	—	—	—	1	—	—
Trimethylamine hydrochloride	—	—	—	—	—	—	0.2	0.08
Ethylene-bis-thioglycolate	—	1	1	0.6	2	2	1	1
"Diak" No. 1	1	—	—	—	—	—	—	—
Mooney Scorch (ASTM D 1077–49T)								
Mins. to 10-pt. rise	13	>45	40	11	>45	>45	—	—
Original (Press cure, 60'/150° C.; Oven cure, 18 hrs./204° C.) (ASTM D 412–57T)								
Tensile, psi.	2190	2820	2650	2600	1980	2050	2470	2400
Elongation, %	250	280	250	230	250	320	185	260
200% Modulus, psi.	1580	1570	1760	2160	1600	1120	—	1650
Compression set (Method B) (D 395–53T)	27	18	20	19	18	*	16	21
Hardness, Shore A durometer	68	65	67	68	71	*	73	69
Aged 48 hrs./550° F. (Circulating air oven)								
Tensile, psi.	1200	910	750	950	brittle	brittle	brittle	830
Elongation, %	190	180	110	110	—	—	—	210
Aged 5 days/500° F.								
Tensile, psi.	1650	1410	1630	1500	1370	1530	1450	1330
Elongation, %	250	300	230	220	150	170	130	250

*Pellets sponged during oven cure.

at much lower press temperatures than are required for mono-amines alone.

Such dithiol cures, moreover, do not require the pretreatment with diallylamine recommended by Griffin and Kelbe[5] in their recent announcement of a room temperature cure of "Viton" A. The combination of *tert.*-amine with dithiols gave fast press cures at 150° C. with less tendency to scorch in the Mooney viscosity test than hexamethylenediamine carbamate (II). The dithiol vulcanizates, after the usual 18-24 hours' oven cure at 200° C., showed higher tensile strength and lower compression sets than those using hexamethylenediamine carbamate only at the same modulus. This paper is a description of the process variables involved in the new curing system.

Three types of ingredient are necessary to the dithiol cure: an amine cocuring agent, a dithiol cross-linking agent, and, an acid acceptor.

Amine Cocuring Agents

The effect of different amines on the properties ob-

[5]"Compounding of Fluoroelastomers for Aeronautical Applications," W. R. Griffin and J. M. Kelbe, WADC. Paper presented at the Fifth Air Force, Army, Navy Conference, Dayton, O., Oct. 15, 1958. RUBBER WORLD, Dec., 1958, p. 408 (abstract only).

tained with dithiols was studied, using as a representative dithiol, ethylene-bis-thioglycolate[6] (III).

$$HSCH_2COOCH_2CH_2OCOCH_2SH \qquad (III)$$

Only strongly basic aliphatic amines gave acceptable vulcanizates. Quinoline, triethanolamine, dimethylaniline and dimethylbenzylamine either were not effective or led to sponging during oven cure. Best results were obtained with trialkylamines and their acid salts. Long-chain amines like dimethyldodecylamine were selected for extensive study because they were less likely to be lost by volatilization during oven cure. The use of amines in the form of their salts also obviated the danger of loss of amine by volatilization and enabled the use of amines of lower molecular weight, which were thus more active on a weight basis.

Primary and secondary mono alkyl amines were effective as cocuring agents, but were not nearly so efficient as tertiary amines, giving vulcanizates of lower modulus and high compression set at a higher level of usage, as shown by columns E and F of Table 1.

Table 1 summarizes some of the results obtained, showing particularly that the scorch time of a formulation was very dependent on the level of tertiary amine used. .

Dithiol Cross-Linking Agents

Many types of dithiol gave good cures in the presence of tertiary amine cocuring agents. α, γ-Polymethylene dithiols, aromatic dithiols, activated dithiols like 2,2′-dimercaptodiethyl sulfide and dithiol esters like (III) were all useful, although the states of cure obtained with different dithiols varied somewhat, reflecting differences in thiol reactivity. The effect of oven aging on properties showed no differences ascribable to difference in type of dithiol, indicating that the chemical nature of the cross-link was not a factor in heat stability. The dithiol ester ethylene-bis-thioglycolate (III) gave stocks which aged as well as stocks containing naphthalene dithiols. Table 2 contains data obtained using some representative dithiols.

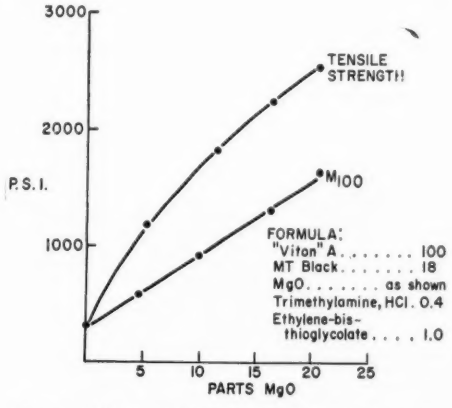


Fig. 1. Effect of MgO on "Viton" A cures with dithiol

TABLE 2. EFFECT OF DITHIOL STRUCTURE ON "VITON" A CURES WITH DITHIOLS

	A	B	C	D	E
"Viton" A	100	100	100	100	100
MT black	18	18	18	18	18
MgO	15	15	15	15	15
N,N-Dimethyldodecylamine	0.5	0.5	0.5	0.5	0.5
1,5-Dimercaptonaphthalene	1	—	—	—	—
2,7-Dimercaptonaphthalene	—	1	—	—	—
2,2-Dimercaptodiethylsulfide	—	—	1	—	—
1,6-Dimercaptohexane	—	—	—	1	—
2,2-Dimercaptodiethyl ether	—	—	—	—	1
Original (Press cure, 60′/150° C.; Oven cure, 18 hrs./204° C.) (ASTM D 412–57T)					
Tensile, psi.	2650	2270	2400	1800	2580
Elongation, %	300	260	260	240	250
200% Modulus, psi.	1600	1620	1850	1280	1750
Compression set (Method B) (D 395–53T)	16	16	25	9	17
Hardness, Shore A durometer	68	67	67	65	65
Aged 5 days/500° F. (Circulating air oven)					
Tensile, psi.	—	1100	1600	1500	—
Elongation, %	—	220	210	210	—

Acid Acceptors

An acid acceptor of the metal oxide type is a necessary ingredient of all known "Viton" curing formulations. The requirements of the *tert.*-amine/dithiol curing system were even more specific. No cure was obtained with any compound which did not contain magnesium oxide[7], and the state of cure developed was directly related to the amount of magnesium oxide used. Figure 1 indicates this effect, being a plot of tensile strength and modulus against magnesium oxide content in a stock using trimethylamine hydrochloride as cocuring agent. Compounds containing zinc oxide, Dyphos[8], and other commonly used acid acceptors were undercured after press cure and sponged badly during oven cure.

Table 3 shows the effect of magnesium oxide content on state of cure, and heat aging properties of a stock containing dimethyl-dodecylamine.

Most of the compounds used to obtain the data of Tables 2 and 3 were black-loaded. Silica-loaded stocks were stiff, but gave high tensile strengths. An example is given in Table 3 (compound E).

Curing Cycle

Like all other curing systems for "Viton" A, the dithiol system requires a two stage cure. The results reported in this paper were obtained with a press cure of

[6]Evans Chemetics Co., New York, N. Y.
[7]Keasby & Mattison, Ambler, Pa., KLC grade magnesium oxide used throughout this study.
[8]Tribasic lead phosphite, National Lead Co., New York.

TABLE 3. EFFECT OF MAGNESIUM OXIDE ON DITHIOL CURE

	A	B	C	D	E
"Viton" A	100	100	100	100	100
MgO	2.5	5	10	15	15
MT black	18	18	18	18	—
Hi-Sil 202*	—	—	—	—	15
N,N-dimethyldodecyl-amine	0.5	0.5	0.5	0.5	0.5
Ethylene-bis-thioglycolate	1	1	1	1	1
Original (Press cure, 60′/150° C.: Oven cure, 18 hrs./204° C.) (ASTM D 412-57T)					
Tensile, psi.	1950	2100	2250	2650	2800
Elongation, %	400	340	240	300	310
200% Modulus, psi.	540	820	1360	1600	1750
Compression set (Method B) (D 395-53T)	17	16	17	16	—
Hardness, Shore A durometer	63	65	67	68	—
Aged 48 hrs./550° F. (Circulating air oven)					
Tensile, psi.	900	1100	1050	†	†
Elongation, %	190	160	100	—	—

*Precipitated hydrated silica, Columbia-Southern Chemical Corp., Pittsburgh, Pa. This material is not now available, but Hi-Sil 233 is a similar grade.
†Brittle.

60′/150° C., followed by an oven cure of up to 18 hours. The necessity for this oven curing operation is demonstrated by Figure 2 which shows how the properties of a dithiol-cured "Viton" compound improved during the oven curing cycle.

Summary and Conclusions

The results reported in this paper show that dithiol-cured "Viton" A has high tensile strength and low compression set, good aging at 204° C.; in addition, dithiol cures can be formulated to give much better resistance to scorch than cures with "Diak" No. 1. Heat aging at very high temperatures of the order of 550° F. is somewhat inferior to that obtained with "Diak" No. 1. Unless great care is taken in formulation and too high a degree of cure is avoided, stocks embrittle after 48 hours at 550° F., somewhat more than stocks cured with "Diak" No. 1. At 500° F., air oven aging properties of dithiol stocks are similar to those containing "Diak" No. 1.

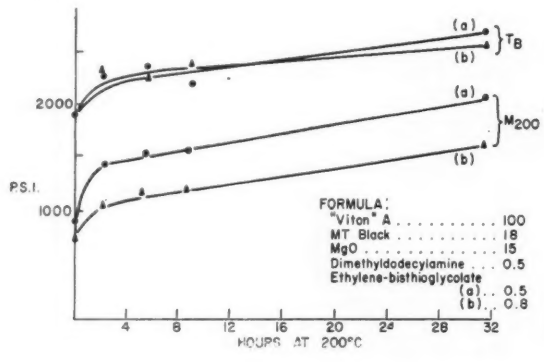


Fig. 2. Rates of cure of "Viton" A with dithiol

The development of dithiol/tertiary amine cures of "Viton" A should extend the versatility and usefulness of this polymer. Such cures, however, do not now appear so attractive for general commercial use as diamine or amine derivative cures, because of their poorer resistance to extremely high temperatures.

Thermistors for Tire Cord Checks

A study on the use of semi-conductors for measuring the temperature developed in tire cords has been reported in the Russian journal, *Kauchuk i Rezina*,[1] and is summarized below.

The formation of heat in tires, which causes them to reach temperatures of 80-120° C., is one of the main reasons for premature deterioration of the tires. To evaluate the capacity of heat formation of the rubber and tire cords an apparatus was constructed for measuring the temperature in the cord fibers by a contactless convection method using thermistors. These thermistors have no direct contact with the cord, but do react to changes of temperatures in the cord.

The thermistors were made from a mixture of manganese oxide and cobaltic hydroxide; their main advantage is that they have a large temperature coefficient of resistance amounting to -3 to -6% for 1° C. change in ambient temperature. They can be made with high ohmic resistance. The ones used here had a resistance of the order of 40,000 ohms.

In this method, heat formation in the cord was measured on a 24-strand test machine, constructed by A. S. Skachkov, of NIIShP, for testing the endurance of tire cords by repeated tensile deformation. The strands are stretched and relaxed to a sinusoidal load pattern and at a frequency of 616 cycles per minute. The actual loads to which the strands were subjected were checked with strain gages. The load pattern had equal time of loading and unloading. Tests were also made with a load pattern where the time of loading (0.037-sec.) was approximately half the time of unloading (0.0603-sec.).

With symmetrical loading, the strands endured more than one million cycles, and their temperature was stabilized at 42° C. With the other load regime, the strands failed at 7,369 cycles, and attained a maximum temperature of 84.5° C. The strands were of Kapron (nylon).

In the former case, the temperature stabilized fairly quickly. After 10 minutes' endurance test with the symmetrical load regime the strands had stretched 3.2 mm., and in the same time with the other regime the strands stretched 7.8 mm.

In this test the surface of the thermistors turned toward the cord is very small (1.5 mm^2), and the radiation emission of the cord during its deformation plays little part when the temperature of the cord is being measured.

[1] 6, 17 (1958).

MEETINGS and REPORTS

Merits of White Pigments Stressed at Akron Meeting

The spring meeting of the Akron Rubber Group on April 3 developed some interesting information as a result of the symposium on "Inorganic White Reinforcing Agents and Fillers." V. H. Vodra, Rubbermaid, Inc., program coordinator, urged the adoption of descriptive group names for calcium carbonates of various particle sizes; C. A. Carlton, J. M. Huber Corp., emphasized that the particle size and the shape of rubber-grade clays are of major importance to the compounder; Ralph F. Wolf, Columbia-Southern Chemical Corp., made the point that there is no fundamental or chemical reason why silica cannot be made as good as carbon black for reinforcing rubber compounds; E. E. Whitted, Faultless Rubber Co., explained the merits of calcium carbonates for drug sundries in addition to their low cost; and R. S. Havenhill, St. Joseph Lead Co., reviewed the composition, properties, and uses of talc, mica, barytes, titanium dioxide, and zinc oxides, providing a rather complete discussion of the manufacture, types, and technology of use in rubber of the zinc oxides.

The afternoon technical program was followed by the usual suppliers' cocktail party and dinner in the Sheraton Hotel in Akron at which 500 members and guests heard Arthur A. Schuck, Chief Scout Executive, Boy Scouts of America, speak.

The Dinner Program

Retiring Group Chairman, George Hackim, General Tire & Rubber Co., presided at the dinner meeting. Sheldon Nicol, Goodyear Tire & Rubber Co., chairman of the Group's scholarship and education committee, first introduced scholarship students at the University of Akron and then also announced the results of the election of officers of the Group for the 1959-60 term as follows: chairman, Milton Leonard, Columbian Carbon Co.; vice chairman, I. J. Sjothum, Firestone Tire & Rubber Co.; secretary, John Gifford, Witco Chemical Co.; and treasurer, C. W. Stalker, General Tire.

Dr. Schuck chose as his subject, "Ideas and Ideals," and in an inspiring address showed how the idea of the scouting both in this country and abroad has done much to strengthen and preserve worthwhile ideals for boys and young men down the years.

Non-Black Pigment Symposium

James Hostettler, General Tire, of the Group's program committee, opened the symposium on "Inorganic White Reinforcing Agents and Fillers" and then turned it over to Mr. Vodra, who acted as program coordinator.

"A Challenge to the Rubber Industry" was the title of Mr. Vodra's paper which had as its purpose a survey of the field of the white reinforcing agents and fillers. He explained that although it was carbon blacks that made rubber tough, long wearing, and good processing, public demand for colored items is increasing, and that the time is approaching when rubber chemists will need to know non-black compounding as well as they know the compounding of black rubber goods.

It was emphasized that carbon black manufacturers have done an excellent job of familiarizing the rubber compounder with the proper selection and use of blacks, but that such has not been the case for many of the non-black pigments.

Numerous electron microscope photomicrographs of non-black pigments were shown in order to provide a comparison between them and the more familiar carbon blacks. These included silica pigments, clays, a wide range of calcium carbonates, zinc oxides, titanium dioxides, talcs, etc. Mr. Vodra made the point that the differences between the extremes of a single family of non-black fillers may far exceed the differences between the extremes of all the rubber-grade carbon blacks. He presented data to show the relation between the physical properties of extremes of particles sizes of carbon blacks and calcium carbonates in natural rubber and SBR.

Data in the form of graphs were also presented to show the effect on tensile strength, tear resistance, and resistance to flex-cracking of calcium carbonates of a range of particle sizes in both natural rubber and SBR. In addition, extensive data show that calcium carbonates of similar particle sizes and surface areas impart similar tensile, tear, and flex properties regardless of their method of manufacture.

Mr. Vodra recommended that carbonates be classified by names according to their particle sizes since their behavior in rubber is more dependent upon their size than their method of manufacture. Compound development workers could then predict finished product test results with more accuracy; production men and purchasing agents would be better equipped to know what products could be substituted in times of shortages; and research work would take on greater meaning if members of different particle size groups were compared rather than using several members of the same group, it was said. The following suggestions for group names and particle sizes were made by Mr. Vodra:

Ultra-fine	under 0.1 micron
Fine	0.1 to 1.0 micron
Medium	1.0 to 3.0 microns
Large	Over 3.0 microns

A similar breakdown might prove desirable in other families of non-black reinforcing agents and fillers, this speaker added.

"Clays for the Rubber Industry" were next discussed by C. A. Carlton. The term "clay" covers the entire range of hydrated aluminum silicates from kaolin containing two moles of silica to one mole of alumina to the bentonitic types containing 5-6 moles of silica to one of alumina. The kaolin type is the one of most interest to the rubber industry. The terms "hard" and "soft" clays are used only in the rubber industry and refer to the effect on the properties imparted to a rubber compound rather than to the properties of the clay itself.

In the United States, Georgia and South Carolina account for the bulk of this country's production of the soft rubber grades, while the entire world's supply of the unique hard rubber grade is produced within a radius of a few miles of Langley (Aiken County), South Carolina, Mr. Carlton said.

The production of clay for industrial use involves mining and processing. Processing is accomplished by either dry process of air flotation, or wet process or classification in water suspension. The bulk of rubber grades is produced by the dry process. Details of the two processes were explained and illustrated.

Although kaolin represents only

about 5% of the total clay of all types consumed in this country, it is used in larger tonnages by North American industry than any other pigment. The paper industry consumes about 50% of the total kaolin, rubber 12%, refractories 10%, and pottery 10%.

Clay is used in rubber because of its reinforcing and stiffening properties and because of its low cost in comparison with other rubber pigments. The chemical composition of rubber-grade kaolin-type clays is of little import since except for slight variations in the most significant impurities of iron and titanium oxides the entire range from soft to hard clays is practically identical in composition. Mr. Carlton emphasized that all clays should be checked for the presence of copper and manganese, however, since many of the clays from outside the Georgia-South Carolina area contain these metals in amounts sufficient to be deleterious to rubber.

The properties of most significance to the rubber compounder are sieve residue, particle size, particle shape, color, and moisture. Low sieve residue is of extreme importance because it usually consists of free silica in the form of quartz that is very abrasive to mixing equipment and trimming knives, and mica which causes die build-up in some extrusions.

The properties imparted to rubber compounds by kaolin clays are dependent on the hexagonal plate shape whose thickness is much less than its length or breadth and percentage of particles in the finer-than-two-microns and coarser-than-five-microns range. The table below shows the particle size distribution range of rubber-grade clays from the softest of the soft to the hardest of the hard.

PARTICLE SIZE DISTRIBUTION

	Soft	Hard
Finer than two microns, %	50-55	87-92
Coarser than five microns, %	25-30	3-5

Mr. Carlton provided data to show that the quantitative differences in the properties imparted to rubber by different types of rubber-grade clays is dependent on the rubber hydrocarbon in which the comparison is made, and on the level of clay loading used. Tensile strength decreases with increase in clay loading in natural, neoprene, and styrene-butadiene rubbers except with hard clay in SBR 1502 where maximum tensile is obtained at 40-volume loading. Modulus in SBR increases very little until an 80-volume loading is reached. In natural rubber, the increase of tear resistance with clay loading is moderate; while in SBR 1502 at a loading of 80 volumes of hard clay the tear resistance is far superior to that of natural rubber. In neoprene, resistance to tear with clay loading is far superior to that of either SBR or natural rubber at all loadings.

In conclusion, Mr. Carlton pointed out that the coarser soft clays can be fractionated to yield a clay having a particle size equal to that of a hard clay as measured by the conventional sedimentation method, but that the properties imparted to rubber are quite different, praticularly as regards stiffness of both the unvulcanized and the vulcanized compound. These facts underscore again the importance of particle shape on the properties imparted to rubber compounds."

"Silicas and Silicates" were described by Mr. Wolf. He explained that reinforcing silicas are produced by either the wet process in which silica is precipitated from a solution of water soluble silicate as is Hi-Sil 233 (Columbia-Southern), or by a thermal dry process. Examples of the latter are Aerosil, developed originally by Degussa in Germany, but now made in this country as Dow-Corning's Fine Silica and Cabot's Cab-O-Sil.

Flow sheets of the wet process for Hi-Sil 233 and the dry process for Aerosil, D-C Fine Silica, and Cab-O-Sil were given, and these processes described in some detail. It was explained further that the thermal silicas have a particle size of 0.015- to 0.020-micron, which is finer than the 0.022 to 0.024 range for precipitated silicas. An important difference between the thermal and precipitated silicas is the cost of production, and as a result, the former sells for 67¢ a pound and the latter for 8¼¢ a pound.

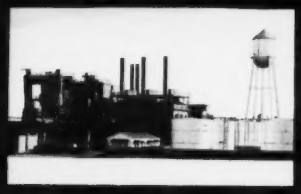
There is no fundamental physical or chemical reason why silica cannot be made as good as carbon black for reinforcing rubber compounds, it was said. From the physical standpoint, reinforcing silica already has a particle size somewhat finer than that of HAF black, and, chemically, the silicas have extremely active surfaces. Also, reinforcement depends not only upon the pigment, but on the elastomer. Hi-Sil 233 imparts better properties to polar rubbers (e.g., chloroprene, chlorobutyl, nitrile or carboxylic rubber) than it does to non-polar rubbers (SBR). It may be possible to design synthetic elastomers specifically for use with silica and that such a rubber and silica will complement each other just as SBR and furnace blacks happen to complement each other more or less by chance, it was said. Tests have been reported in which Hi-Sil 233 gave better road wear than HAF black in tires made from an experimental butadiene-methyl vinyl pyridine copolymer.

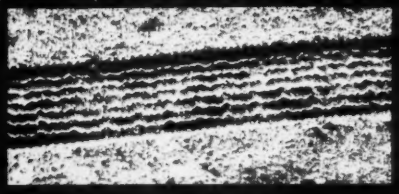
Some of the differences and similarities between HAF black and Hi-Sil 233 were given with special reference to particle size, surface area, pH, ash and oil absorption. Physical properties of natural rubber compounds containing 20-, 30-, and 40-volume loadings of Hi-Sil 233 and HAF black were presented next.

It was emphasized that the relatively low modulus and high elongation imparted by the silica are probably the reasons for the excellent flex resistance of silica stocks that also have high tensile strength, tear and abrasion resistance. These features have accounted for the increasing use of Hi-Sil both alone and in mixtures with blacks in industrial goods such as belting and hose where flexing is important.

Pelletization of silica has proved difficult because of the low solids content of the water slurries and the increased drying costs as compared with those for carbon blacks. Excessive stiffening of rubber by silicas is best reduced by the use of plasticizers of vegetable origin, and it is advisable to use additives such as glycols or amines if fast, tight cures are desired, particu-

Panelists and Akron Group program committee member at white pigment symposium: *left to right, standing:* J. Hostettler, program committee member; C. A. Carlton; V. H. Vodra, program coordinator; *seated, left to right:* R. S. Havenhill, E. E. Whitted, R. F. Wolf

From here 

to here 

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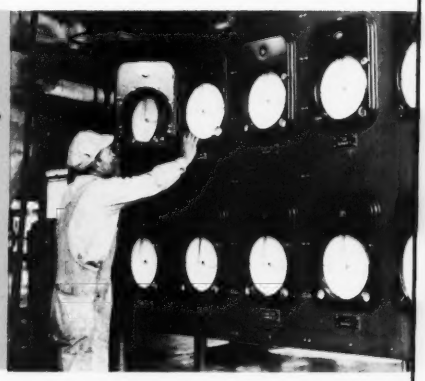

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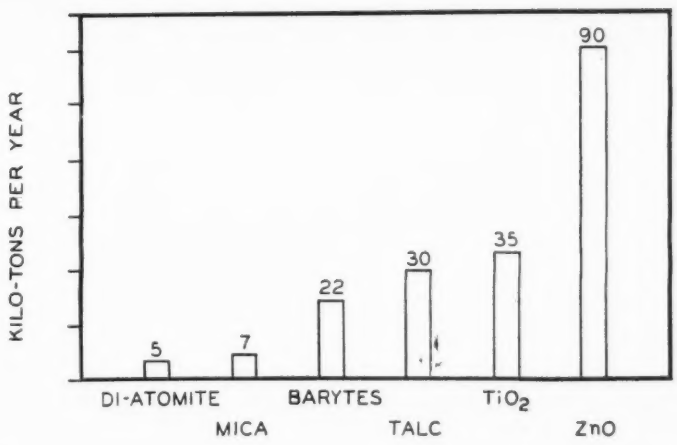


Fig. 2. Rubber industry consumption (1956) of certain white pigments

larly with SBR. Although tests have shown Hi-Sil to be harmless, this fact does not mean that other hydrated, amorphous silicas should be used without a full report on toxicity.

The reasons for the use of reinforcing silicas in the production of rubber goods were summarized as follows:

1. They are used alone to produce non-black goods which must have the highest possible physical properties and in combination with precipitated calcium carbonates where somewhat lower quality is acceptable.

2. They are used to give some strength to cheap, non-black SBR compounds highly loaded with clay or ground whiting.

3. They are used to produce transparent and translucent compounds. No other commercially available pigments are suitable for this purpose.

4. They are used to prevent oil blooming from the newer oil-extended polymers which contain non-discoloring paraffinic oils, which oils will bleed out of the elastomer to a greater degree than naphthenic oils unless the elastomer is tightly cured in the presence of an oil-absorbing pigment such as Hi-Sil 233.

5. They have found wide use in both neoprene and nitrile rubber compounds used in the manufacture of molded oil-well specialties.

This paper was concluded by a review of the present status of colored tires. Columbia-Southern does not feel that the colored tire will be the biggest outlet for reinforcing silica during the next ten years, but the company does believe that the silica will be used as an economical partial replacement for carbon blacks in tire treads. Although the road wear of all silica treads is not so good as that of all black treads, it appears that the abrasion resistance of the mixtures is not a straight-line function of the amount of each reinforcing pigment present, but lies closer to that of an all-black compound than would be expected.

"Whiting" was discussed by E. E. Whitted, who reminded his listeners that the calcium carbonate field covers a family of materials that has a wider range of properties than almost any other group used in rubber compounding. Dry ground limestone, selling for as little as $8 a ton and having a particle size of 30-40 microns, is at one end of the scale, and ultra-fine precipitated calcium carbonates, selling for about $160 a ton and having a particle size thousands of times smaller, are at the other end.

Air floating was the first means used to develop a finer, more uniform ground limestone, and this was followed by water grinding. It was the precipitated calcium carbonates that provided the biggest improvement in properties, however, and the carbonation, lime-soda, and ammonium chloride-sodium carbonate processes for the manufacture of the ultra-fine precipitated calcium carbonates were described in some detail.

Data on physical properties produced in natural rubber by 30-volume loadings of dry ground whiting, ultra-fine precipitated calcium carbonate, a surface-treated precipitated calcium carbonate, and a hard clay were presented and explained. Similar data were given for these materials in SBR 1502, and the advantages of the finer particle size materials became more evident.

Early GR-S water bottle compounds made with the hot rubber of this type were compared with those made with the present SBR 1502 in which the improved physical properties obtained with the cold rubber and the use of surface-coated fine particle size calcium carbonates were emphasized.

The use of fine particle size calcium carbonates both alone and mixed with some ground whiting for cost reduction was described in other drug sundry compounds made from natural rubber and SBR. Calcium carbonates have not been as useful in neoprene, nitrile, or butyl rubber compounds except where the ultimate in physical properties is not required.

Calcium carbonates may find a place in most any compound, even black ones, Mr. Whitted said. Some of the products that are made better or cheaper, or both, by the use of these fillers include soles and heels, matting, housewares, floor tiling and cove, extrusions, wire insulation, bathing accessories, latex and polyurethane foams, belting, hose, and countless other mechanical rubber goods.

"Miscellaneous Reinforcing Agents and Fillers," by Robert S. Havenhill, was the final paper of the symposium. Figure 2 was first shown to provide figures on the relative consumption in thousands of tons per year (1956) by the rubber industry of these materials which included diatomaceous earth, mica, barytes, talc, titanium oxide, and zinc oxide.

Dicalite (Great Lakes Carbon Co.) and Celite (Johns-Manville Corp.) are the commercial names for diatomaceous earth which consists of 85 to 95% silica and has cells of high porosity. Because of its peculiar particle shape and porosity it imparts high modulus to both cured and uncured stocks, and its use to increase the tensile strength of silicone rubbers has also been reported.

Mica, a hydrated potassium aluminum silicate, has a plate-like structure which makes it a good dusting agent for uncured stock and is also used in water dispersions as an inside tubeless tire paint to prevent air leakage. Mica can be obtained in both dry and water ground varieties, and the finer water ground material has also been reported to be a good filler for SBR, Mr. Havenhill declared.

Talc or soapstone is a ground and processed natural hydrous magnesium silicate. Another variety is pyrophyllite, which is a hydrated aluminum silicate. These materials have a platey and tabular particle shape which makes them good dusting agents for uncured stocks; the finer particle size grades are used as extenders and inert fillers.

Barytes is a dry ground and processed natural mineral known as Barite and consisting of barium sulfate. Its particle size is about 15 microns; it is very inert and has no effect on cure or aging, but because of its large particle size does decrease the tensile strength of the rubber compound. It is used in acid-resistant stocks and in those where a high specific gravity is required.

Blanc fixe is a precipitated barium sulfate of much finer particle size of about 0.5-micron. The tensile strength and tear resistance of compounds in which it is used is better than those obtained with barytes.

Titanium dioxide is obtained from the minerals Ilmenite and Rutile by either the sulfate or chloride process. It is made in two types; the rutile has a higher specific gravity and refractive

index and consequently greater hiding power than the anatase variety. The anatase variety is, however, a whiter color, is somewhat cheaper, and is in more general use in white wall tires and other light-colored stocks and for pastel shades. Titanium dioxide has the greatest covering power and tinctorial strength for producing white rubber goods because of its high refractive index.

Zinc oxide is made by volatilization of zinc and subsequent oxidation or burning of the zinc vapor in air to form zinc oxide by two main processes, the French or indirect process, and the American or direct process.

French-process zinc oxides are made by a combustion of metallic zinc which has previously been recovered from ore in a separate furnace. The Kadox process of New Jersey Zinc Co. is a modification of the French process whereby air for oxidation is supplied through jets, and the high air velocities produce extremely low temperature oxidation of the zinc vapor, thus producing an extremely fine particle size zinc oxide.

In the American process the furnace is charged with ore and coal; the latter produces the heat for smelting and also serves as the reducing agent to smelt the zinc ore to zinc vapor, which is subsequently burned in air to zinc oxide. The electrothermic process is a modification of the American process, but uses coke for reduction instead of coal, thus eliminating volatile sulfur compounds from the zinc oxide, and electric power in place of coal for producing and regulating the smelting temperature. Any size particle from very fine (under 0.2-micron) to over 0.45-micron can be produced by controlling the oxidation temperature at the manifolds by adjustment of the dampers. A diagram of the St. Joe Electrothermic furnace was shown, and the process explained in some detail.

Normal French-process zinc oxide has an average numerical diameter as measured with the light microscope of 0.28- to 0.35-micron; it is not quite so crystalline as American-process zinc oxide, and any lead or cadmium in the metal will be found as PbO or CdO. In the French-process zinc oxide, 0.06% PbO is as active as 0.15% basic lead sulfate in the American-process type, and the PbO not only darkens the color of the cured rubber, but also activates accelerators such as mercaptobenzothiazole. Commercial grades of normal French-process zinc oxides were given as: XX #78 (New Jersey Zinc Co.), ZZZ #66 (American Zinc Sales Co.), #109 (Eagle-Picher Co.), and Green #42, #43, and Red #30 (St. Joseph Lead Co. electrothermic process grades having similar characteristics).

Some of the finest particle size grades are those made by the Kadox modification of the French process. Activation effects are very pronounced. Kadox #15 and #72 (N. J. Zinc Co.) and Black #20 (St. Joseph Lead Co. electrothermic process grade having similar characteristics) are representative of these types.

American-process zinc oxide has particle size ranging from 0.28- to 0.35-micron, is highly crystalline, and slow curing because of 0.2 to 0.3% total sulfur normally present as basic zinc sulfates. Lead and cadmium, if present in the ore, will be present as sulfates, and although the lead sulfate will not be so active as the PbO in the French-process zinc oxide, the cadmium will still be active in retarding low-temperature cures of stocks containing thiuram accelerators. Some commercial grades of American-process zinc oxide are as follows: XX #4, XX #203 (N. J. Zinc Co.), ZZZ #44, ZZZ #55 (American Zinc Sales Co.), #320, #330 (Eagle Picher Co.), and Green #42 A 3, Red #31 (St. Joe).

Practically all of the primary producers are making surface-treated zinc oxides for faster incorporation and better dispersion in rubber. The greater dustiness of coated zinc oxide can be reduced by pelletizing.

Slightly more than 50% of the zinc oxide used in the rubber industry is for activation of the organic accelerator, and Mr. Havenhill presented some information on the chemical reactions involved. He then provided data in the form of graphs on the effects of the various grades and types of zinc oxide on tensile strength and modulus in 20-volume loadings, first for DOTG accelerated and then for MBT accelerated stocks. The effect of variations in acidity or sulfur content on tensile rate of cure curves was also presented.

Miscellaneous uses of zinc oxide in white wall tires, in motor mounts, and in electrical insulation were mentioned as was the use of zinc oxide in latex compounding.

Mr. Havenhill concluded his talk with some data on the effect on tensile and modulus of the several fillers described earlier and zinc oxide and with mention and demonstration of the electrostatic theory of reinforcement developed by him.

Inorganic Polymers at Northeastern Symposium

The winter's worst storm in the Boston area proved to be tough competition for the joint meeting of the Northeastern Section, ACS, and its Elastomer & Plastics Group, held March 12 at Massachusetts Institute of Technology, Cambridge, Mass. About 50 members managed to attend the afternoon symposium on "Inorganic Polymers," the social hour and dinner in honor of the speakers, and the evening speakers on "Polyethers."

The inorganic polymer symposium was moderated by Dr. Eugene G. Rochow, Harvard University. The first speaker was Iral Brown Johns, Jr., Monsanto Chemical Co., who discussed "Semi-Inorganic Polymers Containing P-N, B-N, B-O, and B-O-P Linkages." The other speaker was Juan C. Montermoso, Quartermaster Research & Engineering Command, who covered "New Organotin Polymers for Military Applications."

The speakers described the preparation and the properties of their new materials and indicated some of the industrial and military uses these inorganic polymers are expected to fill.

The evening talk on "Polyethers," by Dr. Charles C. Price, University of Pennsylvania, covered a history of the early work on these polymers as well as a summary of present knowledge on polyethers, which have been called the first successful polymers.

Montreal Reclaim Panel

A night for fun and a night for work were held recently by the Quebec Rubber & Plastics Group in Montreal, P.Q., Canada. The night for fun was a very successful Ladies' Night on February 27. Victoria Hall in Westmount, P.Q., was decorated for the affair in the yellow and blue colors of the Group. About 150 couples attended and were treated to entertainment and the drawing of door prizes.

The Group got back to work in March when it held a panel meeting on the 19th on the subject, "Reclaimed Rubber." This meeting was held in the Queens Hotel, Montreal, with the cooperation of the American Rubber Reclaimers Association.

The panel of six speakers was moderated by O. R. Huggenberger, Dominion Rubber Co., Ltd. J. M. Ball, Midwest Rubber Reclaiming Co., spoke on "What Is Reclaimed Rubber and How Is It Made?"; Paul J. Mester, Naugatuck Chemical Division, United States Rubber Co., discussed the types of reclaimed rubber available; W. R. Macy, B. F. Goodrich Co., described the use of reclaim in tires and other transportation items; John E. Brothers, Ohio Rubber Co., spoke on the merits of reclaim in molded goods and other non-transportation items; John E. Misner, Xylos Rubber Co. Division, Firestone Tire & Rubber Co., explained what premixes are and how they can best be used; and Croft Huddleston, U. S. Rubber Reclaiming Co., Inc., listed many of the major reasons for using reclaimed rubber. The presentations were well received and set off a lively discussion period following the formal panel talks.

Chicago Rubber Group Panel Gives Latest Carbon Black Information

A symposium designed to offer "The Latest Information on Carbon Blacks" was the feature of the Chicago Rubber Group meeting on March 13 at the Furniture Club, Chicago, Ill. The technical meeting was preceded by the annual O'Conner Oyster Bar supplied to the members through the courtesy of Laminar Corp., Greenwich, Conn.

It was announced that the Group's golf outing will be held at the St. Andrews Country Club on July 24.

The panel discussion was opened by the moderator, Milton H. Leonard, Columbian Carbon Co., Akron, O., who introduced the panelists and gave the Group some general introductory remarks about the carbon black industry. The first member of the panel, Merton L. Studebaker, Phillips Chemical Co., Akron, went into the "Chemical Aspects of Reinforcement" for the Group. Walter R. Smith, Godfrey L. Cabot, Inc., Boston, Mass., then discussed the "Physical Aspects of Reinforcement"; and Carl W. Snow, United Carbon Co., Charleston, W. Va., concluded the program with some advice on "Practical Applications of Carbon Blacks."

In his opening remarks Mr. Leonard noted that the reinforcement of elastomers is a much-debated phenomenon. He explained that the panel would follow through the several ideas on the subject, and that its members would attempt to give an overall picture for general understanding in their joint effort. As background information, a few statistics were quoted. Carbon black was introduced in rubber in 1912 as a colorant, with annual production about 25 million pounds while production in 1958 amounted to 1.577 billion pounds, 78.5% of which was furnace types and 21.5% channel types. The rubber industry consumes about 95% of the total carbon black produced. It was pointed out that this carbon black is not elemental carbon, but an extremely active colloid containing oxygen, hydrogen, sulfur, etc. Although black, it is, according to Mr. Leonard, one of the cleanest, purest materials in the industry.

Reinforcement—Chemical Aspects

In discussing the chemical reinforcement, Mr. Studebaker said that there are two types of chemical properties that must be discussed—chemical reactivity and catalytic activity.

The speaker indicated that carbon black reacts with a host of materials, apparently including rubber itself. Some of the materials with which the rubber chemist is concerned are the ones which are present in a rubber compound during vulcanization. These include sulfur, accelerators and many of their decomposition products, amine activators, hydrogen sulfide, zinc salts, and others. In general, the high oxygen blacks, like the channel blacks, react more extensively with these materials than the furnace blacks. The chief effect of these reactions with vulcanizing ingredients is to remove a portion of them from the stock so that they cannot promote vulcanization. That furnace blacks are more scorchy, cure faster, and produce higher modulus than channel blacks is probably a result of this greater reactivity of the channel blacks toward these other materials. Only part of the differences in these rubber properties is due to the removal of curing agents—another important difference lies in their catalytic activity.

During vulcanization with sulfur, rubber molecules are believed to be linked by C—S—C, C—S—S—C, and/or C—S—S_x—S—C. Consideration of possible reactions leading to the formation of such bonds suggests the following classifications: oxidation reactions of dehydrogenation and mercaptan coupling, and addition reactions of mercaptan to double bond and hydrogen sulfide to double bond (followed by further addition or oxidative coupling).

Work to date indicates that the most important catalytic action of carbon black during vulcanization is in catalyzing the dehydrogenation of rubber by sulfur. According to Studebaker, this can be considered the initial step in vulcanization and probably is a major determinant of both the nature and the number of cross-links formed during cure.

Reinforcement—Physical Aspects

Walter Smith, in discussing the physical reinforcement, said that the improvement in service properties of rubber goods provides striking demonstration of reinforcement. These properties, however, must be a combination of more fundamental properties. Research on reinforcement has been concerned with defining these fundamental properties.

A basic and, no doubt, critical aspect of reinforcement must be associated with the nature of the rubber-filler bond. The physical forces present at the surface of reinforcing fillers appear to be of adequate magnitude to provide sufficient restriction of the rubber matrix without invoking chemical linkages. The chemical composition of filler surfaces is primarily concerned in altering the rate or nature of vulcanization.

Smith stated, however, the nature and the magnitude of filler-rubber interaction do not alone provide a complete physical picture of reinforcement. The strength of rubber lies in its ability to absorb and dissipate energy without undergoing a concomitant abrasion, as is experienced in metals, for example. Carbon black may enhance this ability to dissipate energy and thus reinforce rubber by providing regions in the matrix which can divert a stress concentration. In addition, energy will be further lost through rupture of the filler-rubber interface.

Practical Applications

In his preliminary remarks on the practical applications of carbon blacks, Mr. Snow said that he preferred the word useful over practical and would try to leave some useful information with his audience. He stated that most carbon black evaluation is concerned with the differences in blacks. Particle size and the features defined by the terms surface activity, character, structure, and a few others all indicate differences. It was suggested that we are so full of these differences that we have not, or will not, recognize some of the "samenesses" among carbon blacks when put into rubber.

The ease and the traditional comparing of carbon blacks in rubber at

Carbon black panelists at Chicago Rubber Group meeting

Chicago Group members at the annual O'Conner-Laminar Corp.-sponsored Oyster Bar

equal loadings were suggested as the reason for the awareness of differences. Comparison at equal loadings is certain to demonstrate differences in every performance department, if there are differences in particle size.

To demonstrate some of these "samenesses," the speaker took the furnace blacks and oil-extended SBR 1707 and compared vulcanizates at the 60 Shore A durometer level. Using some rules shown, the compounds were designed with 250 parts of MT, 160 parts of SRF, 116 parts of GPF, 94 of FEF, 86 of HAF, and 82 of ISAF to arrive at the level of 60 Shore hardness for all. It was found that there were no essential differences in processing of any of these compounds, as indicated by Mooney viscosity, nor in compression set, nor in heat build-up, although modulus was variable, tensile strength increased, and scorch time decreased with decreasing particle size, and extrusion characteristics were dependent on type of black.

It was then demonstrated how, by the addition of equivalent ratios of black and oil, these base compounds could be diluted to lower and lower tensile levels and hence lower cost, but all at the same hardness. MT was chosen since the amount of oil required was not so great as with some other grades of black. It was shown, however, that the information for MT would also apply to the other furnace blacks. One point shown in this dilution study was that a higher-quality base compound can be diluted to a cost equal to that of the lower-quality bases and still have a higher tensile. This was used to suggest that perhaps all base compounds are too heavily loaded for their greatest tensile-cost return.

Snow suggested that with reference to compound development, compounders examine the possibility of having one or two, certainly not over three, high-quality SBR-black bases which could be properly adjusted downward at will.

ASTM D-13 Meets on Textiles, Tire Cords

Committee D-13 on Textile Materials of the American Society for Testing Materials held its spring conclave on March 17-20 at the Sheraton-McAlpin Hotel, New York, N. Y. Of special interest were the activities of subcommittee A-9 whose task force's purpose is to revise and expand tire cord testing procedures. Past meetings have been held between members of D-13 (textiles) and D-11 (rubbers) of ASTM to determine the jurisdiction of each committee in such testing. Agreement was reached that D-13 would evolve the required new tests on dipped or rubberized cords, such as dip pickup, flex fatigue, hot shrinkage, air wicking, and growth. D-11 would be responsible for developing standard methods for adhesion of the cords to rubber.

Tire Cords

A report of the task group of subcommittee A-9 on new tests was given at this spring meeting by the group's chairman, F. J. Kovac, of The Goodyear Tire & Rubber Co., Akron, O. This included the final draft of the rewrite of D 885-56T (Proposed Methods of Testing and Tolerances for Tire Cords from Man-Made Fibers) test procedures and covered greige cord tests on smaller and larger cords than have heretofore been considered of interest, as well as the tests previously listed for dipped and rubberized cords: modulus, growth, heat shrinkage, heat shrinkage force, wet contraction, wet contractile force, dip pickup, and flex fatigue. With the exception of the dip-pickup test, which is considered unfinished, it was voted to submit all the proposed procedures to letter-ballot of the entire subcommittee A-9 membership, to enable formal recommendation to D-13. This report, and acceptance of the procedures for letter ballot, are the result of almost two years' work by a good representation of the fiber, cord, and rubber industries.

Chafer Fabrics

A report of the task group on chafer fabrics was given by Group Chairman M. C. Bullock, of the B. F. Goodrich Co., Akron, O. This included the final draft of a complete revision of the present D 122 procedure which now covers only cotton fabrics. The rewrite covers tests of chafer fabrics from all the fibers and includes such new, yet already widely used tests as air wicking and dip pickup. Both these new tests are of special interest when evaluating the present-day chafers made specifically for tubeless tires, in which the yarns must be thoroughly plugged to prevent air passage longitudinally along the fiber. The air-wicking tests are based on a measuring device developed by Burlington Mills and are now fast becoming the industry standard procedures for checking the efficiency of the special treatment given the fabrics to prevent air leaking. The new write up was voted to be submitted to letter-ballot.

At this meeting of subcommittee A-9 on Tire Cords and Fabrics it was mentioned that it is the policy of ASTM not to use a certification or trade name in its procedures. Also, Tyrex, Inc., will not allow use of its name for Tyrex viscose cord to be used as a generic term. It was suggested by A-9 that the test methods used on Tyrex cord be the same as those used for rayon cord, and A-9 will refer to the ASTM advisory board that this certification name (Tyrex) be footnoted in ASTM procedures.

Fabric Test Methods

Chairman of subcommittee B-9 on Fabric Test Methods, N. J. Abbott, Fabric Research Laboratories, Inc., reported that its task group, which is set up to revise D 181 (Standard Specifications and Methods of Test for Certain Heavy Cotton Fabrics for Manufacture of Hose and Belting), decided that no revision was necessary at the present time.

B. L. Whittier, chairman, Committee D-13, has announced that the 1958 Manual of Textile Standards is now available from ASTM headquarters, 1916 Race St., Philadelphia 3, Pa.

ASTM D-24 Recommends Two Carbon Black Standards

A milestone was reached by Committee D-24 on Carbon Black of the American Society for Testing Materials at its meeting February 4 in Pittsburgh, Pa., during ASTM committee week. This fairly new committee recommended two Tentative Methods be submitted to the membership by letter-ballot for adoption as Standards. These will be the first such standards under this committee's sponsorship. The two methods are: (1) Ash Content of Carbon Black (D 1506-57T) and (2) Heating Loss of Carbon Black (D 1509-57T).

Bolt New Secretary

The meeting of the main committee was held following meetings of four of the five subcommittees. N. P. Bekema, United States Rubber Co., chairman of D-24, announced that A. G. Cobbe, secretary of the committee, had resigned and that T. D. Bolt, Godfrey L. Cabot, Inc., had been appointed to fill the term. John E. Smith, J. M. Huber Corp., succeeded J. F. Ambrose as chairman of subcommittee 3, Optical Tests, as announced also by Mr. Bekema.

In summing up the work of the subcommittees, the chairman urged each of the subcommittees to review all tentative methods under their jurisdiction for possible adoption as Standards.

Subcommittee Reports

Subcommittee 1 — Physical Tests. J. F. Svetlik, Phillips Chemical Co., chairman. The principal item for report in this committee was the Mass Pellet Strength Test, commonly referred to as the Western Electric pack test. A task group under I. Drogin, United Carbon Co., Inc., is conducting a testing program on this test. Only a few of the ten different laboratories involved have completed the work so that the report could not be complete. The full program including statistical analysis is expected to be complete for reporting to the committee during the June meeting.

A question on the variation expected within a bag of black will be answered by a series of pack point values which Dr. Drogin will obtain on a whole bag of black. This point was raised since the samples sent to the various laboratories were taken from the bags without riffling or special blending to avoid samples that would represent random sampling.

Subcommittee 2 — Chemical Tests. L. G. Mason, B. F. Goodrich Co., chairman. The first report concerned the study of powdered *versus* pelleted high color carbon black. This task group under F. Lyon, Columbian Carbon Co., as chairman, has found that the errors inherent in the test are greater than the differences between the powdered and the pelleted black. The task group found that the limit on temperature of $\pm 20^{\circ}$ C. allows a 1% variation in results on high color black. This was not felt to be sufficient justification for changing the procedure or revising this test at this time.

The test does not seem to be ideal for high color blacks, and the group recommends that if the paint and ink industry requires a more precise and reproducible test, a new test should be devised. No representatives of paint and ink users were present, and since deviation on rubber blacks is much less than for high color blacks, no further action would be taken.

A question on the correlation of iodine adsorption values with nitrogen adsorption values on channel blacks led to a general discussion on a more rapid method for determining iodine adsorption with at least the same accuracy. The correlation question was answered in general by the statement that the two values agree for channel blacks, but not for furnace blacks. The more rapid test was referred to a task group with Mr. Lyon as chairman and John E. Smith, J. Middleton, Cabot Carbon Co., and A. D. Miller, Firestone Tire & Rubber Co., as members.

At the conclusion of this discussion, Mr. Bekema called attention to the procedures on ash and heating loss. He pointed out that these two methods have been tentatives since June, 1957, and could be considered for adoption as standard procedures. Mr. Bekema moved that the ash and heating loss procedures be adopted. The motion was seconded and approved by the subcommittee.

Subcommittee 3—Optical Tests. John E. Smith, chairman. The results of the letter-ballot on the proposed method of test for the determination of the relative tinting strength of carbon black were discussed. Because there were three negative votes, a large number of abstentions, and a point made by the National Paint & Lacquer Association that a similar test (D 387-52T) was being used satisfactorily in that industry, a motion was made that work be discontinued until such time as a more definite need of the test is established.

A motion to compare this proposed tinting strength test with D 387-52T was also defeated.

A. E. Hicks, General Tire & Rubber Co., reported as chairman of the task group to study possible improvements to give better reproducibility on the Discoloration of Benzene Test for Carbon Blacks, D 1618-58T. The report and the following discussion led to a decision that more work was necessary. The same laboratories will forward hot and cold extracts from the same carbon blacks used previously to the Columbian Carbon laboratory at Akron, O., where photoelectric colorimeter (Lumetron) tests will be run on these extracts. This plan should establish the reproducibility of the procedure.

White sidewall migration tests will also be run to establish if a correlation exists between the benzene discoloration and that obtained on the same carbon blacks in rubber. Goodrich, Goodyear, and Huber will participate in the white sidewall migration stain tests.

Subcommittee 5—Sampling. Ralph O. Treat, Huber, chairman. Two task groups in this subcommittee have been accumulating test data on sampling methods. Task group I has been working on bulk shipments, and task group II on unitized loads. The first group, under John Tallant, Phillips Chemical, reported on results of tests by seven participants sampling hopper cars. The tests showed that samples from the top of the hopper cars are higher in fines than samples from the side spouts. The results, however, indicated that more work is needed.

Future work will try to correlate samples taken from the stream as loaded against samples taken from other locations after the car has been loaded.

The second group, under Dr. Drogin, covered the sampling of unit loads. One sample was obtained from a single bag from each layer of a ten-layer unit. The report indicated no significant difference from layer to layer or from top to bottom.

A motion to have this procedure written up by this task group for the ASTM to cover sampling bag shipments was made and seconded and was approved by the committee. This will be letter-balloted in time to be reported at the June meeting.

NAWMD Hears Wendrow On Status of Reclaim

The history, early and current technology, and the economics of reclaimed rubber were keynoted in a talk, "Reclaimed Rubber—Its Place in the Rubber Industry," presented by B. R. Wendrow, technical manager, U. S. Rubber Reclaiming Co., at the Scrap Rubber & Plastics Institute, April 4, during the forty-sixth annual convention of the National Association of Waste Material Dealers, Inc. Other speakers at the convention, held at

the Edgewater Beach Hotel, Chicago, Ill., were Senator Paul H. Douglas, of Illinois, addressing the NAWMD annual luncheon, and his wife, Mrs. Emily Taft Douglas, former Illinois Congresswoman, who addressed the ladies' luncheon.

Describing first the history and then the early technology of reclaimed rubber, Wendrow stated that his company in 1946 invented the first continuous method for reclaiming rubber. This process, called the Reclaimator, went into full-scale plant operation in 1948 and is now being used to produce a major part of the firm's reclaimed rubber. It takes less than an hour to convert scrap into reclaimed rubber with the process. U. S. Rubber Reclaiming has two active foreign licensees for the Reclaimator process, one in Argentina and one in Italy, with foreign interest running at a high level.

The reclaim industry, continued Wendrow, has the capacity to produce close to 400,000 long tons of reclaimed rubber a year. For the period 1948 through 1958, the industry produced between 250 and 300,000 long tons per year. In comparison to the total new dry rubber used, the reclaimed rubber usage amounts to 18 to 20%. Data for this 10-year period indicate that the reclaimed industry is quite stable, although for the long-range future a gradual increase in the consumption of reclaimed rubber is anticipated.

A breakdown of reclaim consumption for 1958 in this country shows that tires, tubes, and repair materials account for almost 60% of the reclaim used. This figure plus the amount used in hard rubber boxes, covers, steering wheels, and automobile mats and mechanical goods, constituted 77% of the reclaimed rubber consumed in 1958. Though much of this goes into automotive parts, it does not mean that 77% of all the rubber on a car is reclaimed rubber. In actual fact, only 5 to 16% of a tire is generally reclaim. On the other hand, the basic floor mat in a car is, in most cases, all reclaimed rubber. This is one application where synthetic and natural rubbers simply do not process efficiently during the manufacture of the mats.

As for prices, reported Wendrow, first-quality whole-tire reclaim costs 11¢ a pound. During the past decade there have been some small increases in this price. The price of general-purpose synthetic rubber at 23¢ per pound puts a ceiling on the price of a reclaim. The rubber in reclaim (based on a 50% rubber content is 22¢ a pound. The advantage that reclaimed rubber has is due to its basic good properties as well as the valuable compounding ingredients which come with it automatically.

For the future of reclaimed rubber there is no anticipation of tremendous increases in the consumption, though a gradual increase is inevitable, Mr. Wendrow said. Reclaim has always been a factor in the rubber industry, and it is expected to continue. The real, long-range competitor is synthetic rubber, concluded Wendrow, which can be expected to continue its growth. However, competition is an old story in the reclaimed rubber industry. In its 100-year history it has seen good times and bad several times over and has competed against 4¢ rubber.

NSi and Halo-IIR Are Discussed at Boston

Three well-versed speakers, each with many excellent and many colored slides, provided an up-to-the-minute symposium on three of the newer synthetic elastomers for the Boston Rubber Group at its meeting on March 20. Cyanosilicones, halogen-containing butyl, and nitrile silicones were covered as to production, properties, and uses by the speakers, with much of the information being the latest available from the suppliers' laboratories.

The first of the speakers was James H. Lorenz, Union Carbide Chemicals Co., New York, N. Y. Mr. Lorenz gave a comparison of the newer cyanosilicone rubbers with the older methyl silicone rubbers and by so doing indicated the benefits obtained by the addition of the cyano group. The importance of the position of the cyano group on the molecule on the properties was shown with the gamma position being indicated as the most important. It was shown also how the properties would be changed by the amount of the cyanogen incorporated, the length and complexity of the side chain, and the position of the CN group. Typical properties of these cyanosilicones were compared with those of normal silicone rubbers. A whole series of polymers to satisfy the needs of the manufacturer of many molded products, hose, seals, laminates, and other items is expected to develop, according to Mr. Lorenz.

The second speaker was J. V. Fusco, Enjay Co., Inc., New York. He indicated how the halogenation and particularly the chlorination of butyl has led to polymers with many of the advantageous properties of the original butyl, but without some of its disadvantages. Some of the major improvements are increased compatibility with other organic rubbers, increased cure rates using metallic oxide-type cures, faster and higher cure rates generally, flat cure curves, thermal stability, good compression set and flex, and good abrasion and ozone resistance. Some typical compounds and cure systems were shown, and some applications that are expected to make good use of the properties of these halogenated butyl rubbers were indicated.

The closing speaker was Richard Savage, General Electric Co., Waterford, N. Y. Mr. Savage used many colored slides to illustrate his talk, which brought the Group some last-minute information on the new nitrile silicone rubbers now being furnished for evaluation by G-E. It was shown how the oil resistance of the silicone-class rubbers has been improved by these newer members of the family. The properties of the three hardness grades to be introduced were shown, and it was indicated that by changing the amount of the nitrile component, and changing its relative position in the silicone rubber molecule, a complete series can be made to satisfy individual needs. As in most cases, some of the desirable properties may be improved to the detriment of others, and numerous formulas were presented to show the range of uses possible with the most promising nitrile silicones now being produced.

With the foregoing as the afternoon technical session of the Boston Group's spring meeting in the Hotel Somerset, Boston, Mass., on March 20, the approximately 300 members present then followed up with a cocktail hour and dinner. The after-dinner speaker was Norris D. Hoyt, St. George's School, Newport, R. I., who gave an account of his travels with a small boat and his family. The trip was made for publication purposes, and his talk was liberally illustrated with many slides taken during his trips.

Rocket Developments

The story on "Solid Propellant Rocket Fuels," covering from the early production of rockets by the Chinese and early Italians and Greeks up to the present time, was given to a joint meeting of the Wellington/Waterloo Section, CIC, and the Ontario Rubber Group, by James K. Beatty, Thiokol Chemical Corp., Trenton, N. J., on March 10.

Mr. Beatty traced the development from these early beginnings up through the German V-2 rockets of World War II and to today's types such as the Thor, Jupitor, Atlas, and Vanguard. The relative merits of liquid and solids fuels were compared and contrasted in terms of cost, ease of handling, and overall performance. The final section of the talk dealt with the make-up of rockets, how they are handled, present performance characteristics, and future possibilities of the rocket industry in relation to space travel.

The meeting was held at the Royal Hotel, Guelph, Ont., with about 130 present.

Shell Host to NCRG; IR Nebeker Topic

"Polyisoprene" was the topic of H. R. Nebeker, Shell Chemical Corp., Torrance, Calif., who spoke at the technical session on April 9 before the Northern California Rubber Group. The dinner and the business meeting were held at the Zombie Village, Emeryville, Calif., and the Group then adjourned to Shell Development Co.'s new lecture hall to hear Nebeker speak on polyisoprene rubber, the synthetic duplicate of tree-grown rubber which recently went into commercial production at Shell's facilities.[1]

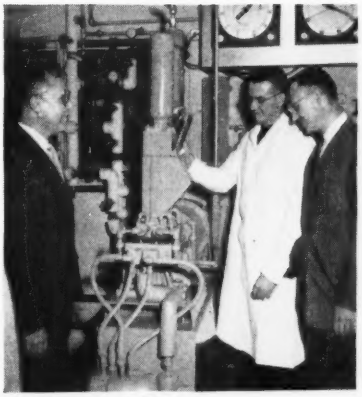
In his talk Nebeker described the new polymer and stated that the synthetic natural rubber can be produced at the rate of five tons per day; the plant capacity within about a year, however, will be 15-20 thousand tons annually. Owing to a new chain of production processes developed by Shell, the new isoprene rubber can be produced at a price competitive with that of natural rubber. Carefully controlled reaction conditions result in an elastomer with uniform properties and light color.

Some typical physical properties of the raw polymer are: color—white; antioxidant — non-staining, non-discoloring; structural purity — 92.6% *cis*-1,4-polyisoprene; organic acid, % wt.—3.0; ash content, % wt.—0.50; intrinsic viscosity—7.0; molecular wt. $\overline{M}_n$—2,750,000; and Mooney viscosity ML 1+4, 212° F.—57.

Nebeker stated that the characteristics of the new rubber will provide ideal raw material for use in various white and light-colored stocks. The ash forming material, equivalent to about 0.2% calcium, is the only component of the rubber not normally present in conventional rubber formulations inasmuch as the organic acid can be substituted for stearic acid in compounding recipes. This extremely low metallic content should, he reported, provide excellent electrical properties for use in such applications as insulating materials, battery separators, etc.

In general, Shell Isoprene Rubber can be processed in a manner similar to natural rubber. When gum stocks are compounded on a mill, however, the new rubber has been found to be somewhat sensitive to high temperatures and may tend to bag on the rolls. Accordingly, the speaker suggested compounding pure gum stocks between 160 to 180° F. to hold a smooth rolling bank and to assure proper dispersion of sulfur and accelerator.

In the case of pure gum stocks, tensile strength studies show reversion upon overcure at a conventional 2.5 phr. sulfur level. By reducing the sulfur concentration to 1.5 phr. this tendency is practically eliminated. On the other hand, compounding the polymer with carbon black essentially eliminates reversion.



Shell Development Co.

H. R. Nebeker *(left)*, F. W. Morss, Shell Development Co., and C. C. Corkadel *(right)*, Oliver Tire & Rubber Co., observe laboratory Banbury mixer at Shell Development Co.'s rubber laboratories

In processing black reinforced stocks, continued Nebeker, the comparatively low Mooney viscosity of the Shell polymer allows it to be charged directly to the Banbury mixer without the preplastication step normal with natural rubber. Pigment dispersion, however, will be improved if the rubber, without pigment, but with antioxidant added, is mixed in the Banbury for 2-3 minutes, using discharge temperatures of 250-275° F. As with SBR and natural rubber, if the optimum charge weight to the mixer is not used, Shell Isoprene compounds may show a tendency to crumble, with the attendent poor pigment dispersion. In addition to care in the selection of the optimum charge weight, indications are, that for improved processing characteristics and black dispersion, the optimum Banbury discharge temperature for polyisoprene is 10 to 20° F. below that of natural rubber.

The speaker presented data showing that in a typical tread stock formulation in which no additional stearic was added, the physical properties of the isoprene rubber stocks were nearly equal to those of natural rubber stocks. There was no evidence of reversion in the reinforced stock even at a sulfur level of 2.5 phr. The tear resistance of polyisoprene at a temperature approaching that of a running tire can be shown to be essentially equivalent to that of natural rubber, said Nebeker, and comparative permanent set results indicate the synthetic to be superior. Also, the resilience and heat build-up in the isoprene rubber stocks are essentially equal to those of NR.

More data were presented by the speaker, comparing isoprene rubber with natural rubber in carcass and breaker stocks. In these applications the synthetic material nearly equals the physical properties of natural rubber. The modulus values for the synthetic stocks were generally lower than those of the control, but, according to the speaker, this slight difference is not important inasmuch as heat build-up characteristics of the two stocks are essentially equal.

With regard to color, Shell Isoprene Rubber is white. The color stability of the polymer, according to aging tests wherein the product was exposed to ultra-violet light for a period of 40 hours and subsequent discoloration measured as a function of reflectance, is at least equal to that of the best natural rubber stocks.

In concluding his talk, Nebeker expressed hope that the industry will be prompted to examine the use of Shell Isoprene Rubber in such applications as tires, truck camelback, conveyor belt carcasses and covers, wire and cable insulation, battery separators, V-belts, and white sidewalls. He also felt that there is a potential market in molded goods, footwear, aircraft tire camelback, adhesives and cements, and in pharmaceutical applications where stringent toxicity, odor, and taste requirements must be met.

Following the lecture, the Group toured the Shell Development Emeryville facilities, including the Van de Graff generator, the rubber testing laboratory, the motor laboratory, and the computer installation.

[1]See RUBBER WORLD, Apr., 1959, p. 112.

Radiation Effects on Rubber Investigated

High-velocity neutrons and gamma radiation are the radiations which may damage rubber items in the vicinity of nuclear reactors since they have much greater penetration through matter than other particles. This fact was reported by Ross E. Morris, Mare Island Naval Shipyard, Vallejo, Calif. Stating that nuclear radiation consists of high-velocity particles and a true radiation having the velocity of light, Mr. Morris said that the high-velocity particles are alpha, beta, protons, and neutrons, and that the true radiation is gamma radiation which is similar to a very short-wave X-ray. He reported that the two which are damaging to rubber, neutrons and gamma, have the same effect apparently when equal energies of each are absorbed.

These statements were made by the

speaker in an address, "The Effect of Nuclear Radiation on Rubbers," given before The Los Angeles Rubber Group, Inc., at the meeting held April 7 in the Biltmore Hotel, Los Angeles, Calif.

Morris also reported that nuclear radiation forms free radicals or ions in rubbers. These react either to create more cross-links in vulcanized rubber or to depolymerize the vulcanizate. The former reaction causes hardening of the rubber; the latter causes softening. Various investigators have shown that cross-linking predominates in most rubbers. Examples of rubbers which are depolymerized by nuclear radiation are butyl rubber and Thiokol polysulfide rubber. The vulcanized rubbers which have the best retention of tensile properties are natural, styrene-butadiene, and acrylonitrile-butadiene, in the order named, according to published information. A vulcanizate of one of the acrylic rubbers also appears to have outstanding resistance to radiation.

Considerable information has been obtained by the Mare Island Rubber Laboratory regarding the effect of gamma radiation on the compression set of various vulcanizates. All vulcanizates tested to date suffered 100% set when subjected to 10^9 roentgens[1] of radiation while held compressed. After 10^8 roentgens some of the vulcanizates had compression sets as low as 50%. The best rubbers in this respect were styrene-butadiene, natural, and the carboxylic derivatives of acrylonitrile-butadiene. Certain antioxidants and other ingredients were beneficial.

Following this technical talk, the Group held its dinner which was sponsored by W. J. Voit Rubber Corp., Los Angeles. About 266 members attended the dinner and heard Arthur E. "Red" Patterson, of the Los Angeles Dodgers baseball club. Red's talk on the Dodgers and baseball was interesting to the Group as a whole, and to the baseball fans in particular.

[1]The roentgen is a unit of measure for X-rays. Some confusion exists in radiation measurement for the layman. The ANP Advisory Committee for Nuclear Measurement and Standards for the Air Force has recommended ergs per gram carbon. Another unit is the rep or roentgen-equivalent-physical. See RUBBER WORLD, Dec., 1958, p. 382.

"Viton" Technology Talk to RIRC by E. Tufts

The story of "Viton" fluororubber was presented to about 180 members of the Rhode Island Rubber Club at the spring meeting on April 2 at the Pawtucket Golf Club, Pawtucket, R. I. The speaker, Edgar Tufts, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., gave the assembly a quite complete look at some of the history of the elastomer, its general physical properties, as well as the outstanding heat and chemical resistance, and some compounding methods and their results.

Mr. Tufts was the featured speaker for the technical session at 4:30 p.m., which was followed by the usual dinner. The after-dinner speaker was Henry Steeger, Massachusetts Council for Public Schools, who spoke on "Position of Laymen in Education." Mr. Steeger's talk evolved a lively discussion on the question of "modern education" *versus* the three R's.

In his talk, "Technology of 'Viton' Fluoroelastomers," Tufts collected much of the information that has been presented by his associates and himself in recent months.[1] The first portion of the report covered a basic description of the elastomer, raw polymer properties, vulcanized properties for stress-strain and low temperature, general characteristics in electrical properties, and the special properties of dry heat and chemical resistance for which the elastomer is most famous.

A second section in the talk provided some of the facts on the newly announced "Viton" latex, LD-242. While this material still is experimental and does not have too much in the way of technological development as yet, typical properties were indicated, and some potential uses suggested and discussed. Basically, however, most of the good properties of dry "Viton" are carried over into the latex product.

In the discussion of specific compounding of "Viton" stocks, information on a new accelerator was included. This recently announced diamine, LD-214, was included in the studies presented along with the previous blocked diamine accelerators Diak[2] No. 1 and Diak No. 2. The value of this new material is expressed in its processing safety which approaches that of the Diak 2, but with cure rate and properties more like the faster Diak 1. The use of these various curing agents provides some latitude in stock formulation.

Another important variant in compounding is the stabilizer which along with the curing agent and fillers comprises the three necessary ingredients. The studies presented covered benefits derived from the use of zinc oxide-Dyphos[3] combinations, magnesium oxide and the importance of the grade used, and the use of litharge as stabilizer.

It was also pointed out that although plasticizers are not generally used in "Viton," some screening has been done to try and obtain better low-temperature properties by using plasticizers. Most materials fail during the 400° F.-cure stage owing to their volatile nature and cause sponging. Some non-volatile materials have been suggested for processing aids as a result of these projects even though they do not improve the low-temperature properties.

The final section of this report gave

Rhode Island Rubber Club speakers and chairman: *left to right*, Henry Steeger; H. W. Day, Du Pont, Club chairman; Edgar Tufts

[1] For further "Viton" discussions see articles and meeting reports in RUBBER WORLD, Nov., 1957, p. 250; Dec., 1958, p. 417; Mar., 1959, p. 890; and Apr., 1959, p. 98.

[2] E. I. du Pont de Nemours & Co., Inc., elastomer chemicals department.

[3] Tribasic lead phosphite, National Lead Co., New York, N. Y.

Happiest marriage of carbon black and rubber produces new Ameripol Micro-Black

When you join carbon black and rubber . . . and hope for the best possible dispersion . . . why make it a "shotgun wedding"? Why injure both of them with excessive compacting and repeated dry shearing? Goodrich-Gulf has solved this problem with "high liquid-shear agitation" in the production of new Ameripol Micro-Black masterbatch.

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This thorough fluid blending means that finished products made with Micro-Black have controlled uniformity, superior dispersion, greater abrasion resistance.

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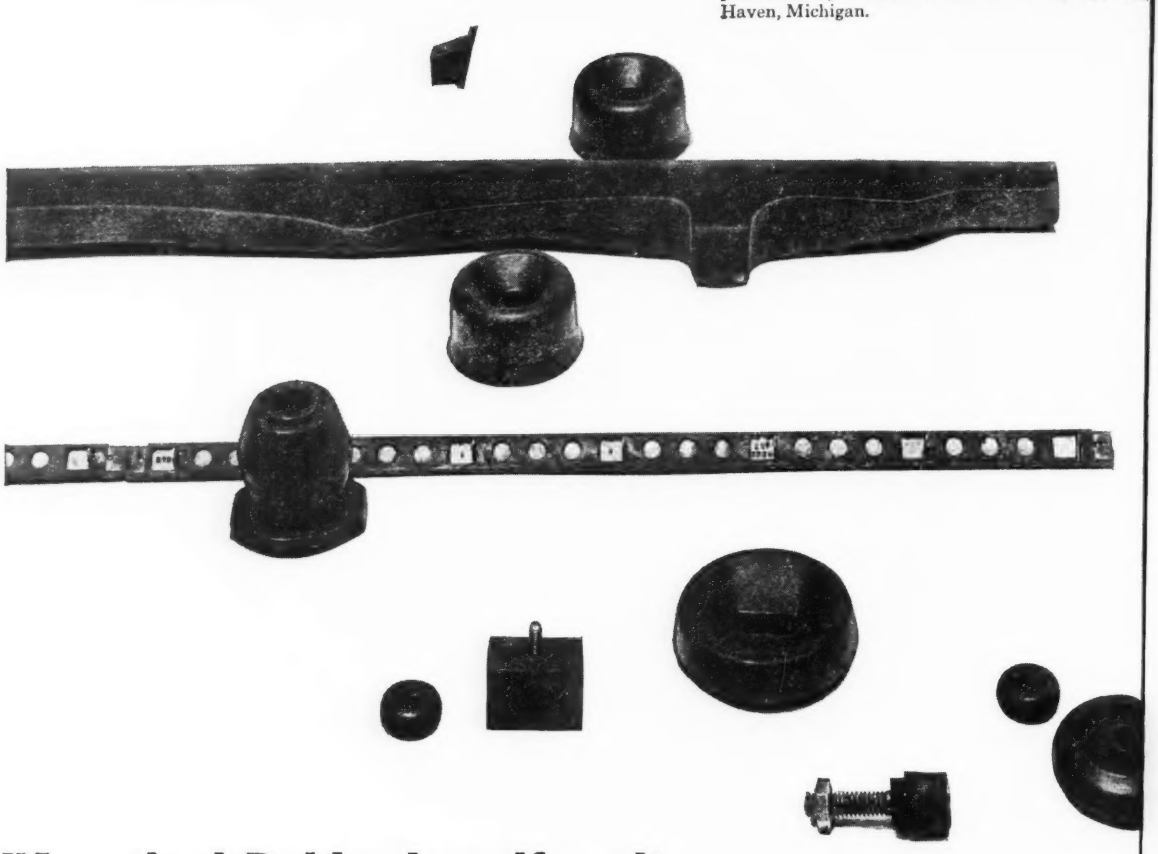
Goodrich-Gulf Chemicals, Inc.

Ameripol Rubber contributes to consistent quality of parts made by South Haven Rubber Company, South Haven, Michigan.



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some of the particular problems involved with the processing of "Viton" in the plant. Normal rubber processing equipment is employed, but, as is the case with many of the newer elastomers, certain tricks of the trade are required for best results. The two-step cure system was also described, with some of the modifications used for specific uses.

Silicone Seals Topic At SAE N. Y. Meeting

"Properties of Silicone Rubber for High-Temperature Static Seals," by H. E. Todd and J. F. Miazga, materials development laboratory, Pratt & Whitney Aircraft Division, United Aircraft Corp., was a paper presented at the SAE National Aeronautical Meeting, held at the Hotel Commodore, New York, N. Y., March 31-April 3. The scope and the results of this paper are summarized below.

The investigation of silicone rubber compounds for static seal applications has demonstrated the importance of tests to evaluate these materials for specific properties at environmental temperatures which simulate anticipated service requirements. Some relations have been established between these properties and compound composition. Certain generalizations can be made which may serve as a guide in the selection of materials for specific applications.

Silicone compounds of 60-70 durometer hardness provide the lowest compression set, but harder compounds are superior for high compressive stress requirements. Compounds containing precipitated silica as a filler show generally superior resistance to open heat exposure and have moderately high compressive stress characteristics. Compounds with fumed silica fillers are somewhat superior in original physical properties, in resistance to confinement at high temperatures, and in compression set at temperatures above 400° F.

Diatomaceous silica fillers, when used alone, furnish only moderate reinforcement to silicone rubber compounds. Di-tertiary butyl peroxide is the best of the catalysts for low compression set and may contribute slightly to improved heat resistance. The pronounced effect of heat on virtually all the properties of silicone rubber compounds indicates a maximum temperature limitation of 500° F. for their successful use in seal application.

In conclusion, the authors indicated that the selection of materials for seals must necessarily result in a compromise of desirable properties and should therefore be based on a careful analysis of the functional requirements of a part to determine the properties most essential to its effective performance.

Fort Wayne Group Gets Advice on Investments

"Planning a Personal Investment Program" was the informative talk presented at the fourth meeting of the 1958-59 season of the Fort Wayne Rubber & Plastics Group held at the Van Orman Hotel, Fort Wayne, Ind., April 16. Speaking before the 173 guests and members at the smorgasbord dinner-meeting was William Kile, accountant executive of Merrill Lynch, Pierce, Fenner & Smith, Inc., of Fort Wayne. His talk included a film ("What Makes Us Tick?") from the New York Stock Exchange.

The specific stock or bond is the last thing one thinks of when planning ones' own investing program, said Kile. The problem does not lie with the security; it lies with the individual. The first thing one should do is to determine how much money he wants to lend and how much he wants to use to buy things with. This latter should be considered the family's living requirements, not investments.

Before investing, one should have a reserve of savings for emergencies and for insurance, but which represents lending money and is therefore fixed dollars which do not fluctuate with the cost of living. Generally speaking, the younger a person is, the larger the percentage of his investments should be in ownership; and the older a person, the higher the percentage in lending. In lending money the watchword is compare.

When one wants to buy and own a stock, he should first think in terms of industries. A young person with growing earning power should think about growth industries, such as chemicals, aluminums, and electronics. Be prepared for wide price fluctuations in growth stocks.

A mature person, yet one still earning money, should invest in mature industries that will pay a good dividend. One with no earning power, retired or widowed, should be concerned about an industry which is well defended against losses. He should use a balance of his funds for lending so that they remain fixed dollars, yet not be entirely in fixed dollars. Public utilities, banks, and insurance companies are examples of well-defended industries.

After deciding how much to lend and how much to invest in stocks, one should consider diversification of stocks. Diversification, as differentiated from scattering, means spreading ownership among several industries and securities. One can follow three, four, even five industries. The selection of specific stocks is the next step . . . which can be done with or without the help of a broker. But a broker can tell which stocks his research department considers to have the best values and prices within certain industries.

People investing in stocks should not make decisions based on an attempt to predict price fluctuations. This is speculating, not investing. If one does speculate, he should be able to afford the consequence of being wrong. A careful study of the past gives information about the character of a given security. But the future will not be exactly as it was in the past. Therefore, do not base an investment decision on an attempt to predict near-term market action. The important lesson of history is change, concluded Kile, and the intelligent investor is prepared to accept the change as the way of life—not trying to outguess the economy from month to month.

New officers and directors of the Group for 1959-60 are: chairman, Walton D. Wilson, R. T. Vanderbilt Co.; vice chairman, Allan Bluestein, Anaconda Wire & Cable Co.; secretary-treasurer, A. L. Robinson, Harwick Standard Chemical Co. Directors-manufacturers are: DeVon Wilson, General Tire & Rubber Co.; and Art Brumfield, Belden Mfg. Co. Directors-suppliers are: Bob Lea, Thiokol Chemical Co.; and Mel Whitfield, Naugatuck Chemical Division, United States Rubber Co.

The new officers will take over June 6. The membership for the group is now 407. The next meeting will be the summer outing on June 5 at Tippecanoe Country Club, Leesburg, Ind.

Adhesive Bond Theory Discussed at Boston

"The Nature of Adhesive Joints" was the talk given by Jacob J. Bikerman, adhesives laboratory, Massachusetts Institute of Technology, before 85 members and guests of the Elastomer & Plastics Group, Northeastern Section, ACS, on April 21. The April dinner-meeting was held at Science Park, Charles River Dam, Boston, Mass.

In his talk Dr. Bikerman took issue with the usual explanations of adhesive failures as primarily dependent on the interfacial forces of adherend and adhesive. He discussed his theory that interfacial separation almost never occurs, and that these failures occur either in the boundary layers, which are weak, or in the adherends or adhesives themselves.

Adhesive values depend, he said, on the absence of unwanted materials in the interface, and on the strength of the materials of the joint. The thickness of the adhesive layer in the joint will also determine the strength of the bond, which increasingly exceeds the strength of the adhesive itself as it becomes thinner than a maximum value,

(*Continued on page 294*)

WASHINGTON REPORT

By JOHN F. KING

Humphrey's Drive for Science Secretary Fails; Form Council

A year has passed since the Democratic leaders in Congress, recovering from the shock of Russia's Sputnik in the Fall of 1957, uncorked their campaign to "mobilize" science for national security by centralizing and coordinating all federal research and development activities[1].

No Cabinet Science Post

Led by Sen. Hubert H. Humphrey, (Dem., Minn.), the Democrats have spurred the Administration into action to streamline certain elements of government programs in this field. But they have failed in the accomplishment of their stated objective: creation of a Cabinet-level Department of Science and Technology. The Humphrey forces have tried the hard-push, through introduction of legislation authorizing the Department of S & T with multiple sponsorship in the Senate; they have nibbled around the edges, riding herd on the science arms of the various executive departments to get them to work together more.

But they have failed to do much more than point the Administration in the general direction of more central control over the Federal Government's 30-odd departmental science programs. It is reasonable to believe that stirrings among scientists themselves, plus public pressure for tangible evidence that the U. S. is keeping ahead of the Russians in this field, have contributed as much to these changes within the government as the heat from Congress.

Council for S & T

Still, the farthest President Eisenhower and his Cabinet have allowed themselves to be pushed is the creation of a "Federal Council for Science and Technology." This purely advisory body was established by Presidential order March 13 this year on the recommendation of Mr. Eisenhower's Science Advisory Committee. The new Council, which has none of the statutory authority the Senators envisage for a Department of S & T, was set up within the Cabinet's family in the hope that it "will improve the planning and management of Government research programs."

According to the executive order, the Federal Council "should carefully examine the plans of individual agencies, and seek to promote full cooperation among them in developing programs that will meet their common scientific and technological needs, but which will eliminate unnecessary overlap and duplication."

Sen. Humphrey's Dissent

It was to be expected that this modest commission would not be enough to satisfy Humphrey and his supporters. Following the issuance of the executive order, Humphrey and other sponsors of S-676, to establish a Department of S & T, issued their dissent through the medium of a March 23 report of the Government Operations Subcommittee on Reorganization, headed by the Minnesota Democrat.

Humphrey said in the comprehensively detailed report that he is gratified "that it is possible to report that real progress is being made in some scientific areas, despite the present disorganization." He referred to administrative steps that have been taken by the various executive agencies, especially by the National Science Foundation and the Commerce Department's Office of Technical Information in their information collation and dissemination service, to straighten out research and development housekeeping setups.

"However, the progress thus far made, through the information program and other programs now actually under way toward effective coordination within the Government of all of the Government's scientific interests, is grievously outweighed by that which still remains to be done," Humphrey declared.

The purpose of the report, he said, is to answer the "outcry" heard from some Administration officials and some scientists against the creation of the new Cabinet-level agency. He said the protest is caused by a misguided fear within the science community of "political interference" should the total activity of the government in research and development be centralized at the highest level.

By way of allaying this fear, he pointed out that similar anxieties over "socialized medicine" were expressed when the government centralized its health programs in the Department of Health, Education and Welfare, but nothing is heard of them now.

To pin down the arguments against the Department of S & T and a more thorough-going administrative program to place responsibility for all federal science within the Cabinet, the Humphrey Reorganization Subcommittee held two days of hearings April 16 and 17. It was a foregone conclusion that the Administration still opposed the Minnesotan's project, and it wasn't long before the basic cleavage appeared.

Administration Position

The Administration's chief witness was former Atomic Energy Commission Chairman and now Commerce Secretary Lewis L. Strauss, himself under the surreptitious fire of the scientific community. It has had a lot to do with the Senate Commerce Committee's unwillingness to confirm him in his new post.

Like his predecessor, Sinclair Weeks, Admiral Strauss didn't get beyond the first page of his prepared statement before requesting that S-676, the Humphrey bill to create the new department, "not be enacted." The Secretary continued:

"It is my opinion after 20 years of working with scientists in Government, and in private research for a number of years before that, I am convinced that science does not lend itself naturally to consolidation or isolation within one organization. Science is a necessary and vital aspect of all our government and all our economy. It is inseparable from the work of charting our coasts, forecasting our weather, providing standards for measurement, as-

[1] See RUBBER WORLD, May, 1958, p. 286; Nov. 1958, p. 249.
[2] *Ibid.*, Nov., 1958, p. 249.

suring the wholesomeness of our food, the expansion of our industry, the reliability and safety of our transport, the strength of our nation's defenses, and the health of our growing population. These are by no means all of the functions to which science contributes."

Lumping government science efforts into one agency might "isolate" them from the daily conduct of public affairs "and thus interfere with the cross fertilization of ideas . . . doctrine . . . and method among the various departments," Strauss said.

He conceded there is a "real need for more effective coordination of our scientific activities," but averred that the President's new Federal Council can handle this problem. He pointed out that, being made up of representatives from the Departments of Defense, Interior, Agriculture, Commerce, HEW, NSF, and the new National Aeronautics and Space Administration and the AEC, the new Council is in "an exceptionally good position to deal with major government science programs and to assure the maximum coordination of effort to the end that we may realize the greatest possible progress from our total scientific activity."

The Admiral concluded: "Science should continue to permeate the entire structure of Government and not be insulated from it. It cannot be rigidly departmentalized save at great sacrifice. Since the Humphrey bill proposes no more than the consolidation of a group of relatively disparate activities into a new Department, little if anything can be accomplished toward solving any of our existing problems in science or assuring our future progress."

More Senate Reports On Industry Research

The Senate Judiciary Subcommittee on Patents, Trademarks and Copyrights has issued another report in connection with its detailed study, authorized in the last Congress, of government-industry cooperation in the promotion of scientific research and development. The latest report, released under the auspices of the Subcommittee, headed by Sen. Joseph C. O'Mahoney (Dem., Wyo.), demonstrates the larger rubber companies, along with the leading American chemical firms, are ranked high among the larger industrial companies in expenditures earmarked for technical research and development.

The report points out most of the 50 top-ranking American firms in the industrial research field own important patent rights as a result of the research of their own employes' studies, plus the purchase of related patent rights of individual inventors. It also observes that thousands of firms of "small-business" size participate in the success of the bigger leaders in research, through varied types of subcontracting arrangements.

Based on recent studies of the National Science Foundation and cooperating governmental agencies, the latest O'Mahoney report states that nearly 20,000 American companies were conducting research and development activities in 1953, the last year a detailed survey of the field was undertaken. At that time, the companies polled employed 400,000 research workers (scientists, engineers, and technicians), of whom 160,000 were scientists and engineers.

The O'Mahoney report further notes that of total expenditures by all industrial companies—a recorded $3.7 billion in 1953 and an estimated $4.0 billion in 1954—the 400 largest companies carried on 72% of the nation's technical research. The 50 largest of the companies, which the report calls the "giants in research," had a total of 3.5 million employes of all types, and each had in the period 1955-57 at least 1,000 specialists in technical research projects. All told, it estimated the 50 "giants" employed by 1955 about 150,000 technicians, including the 50,000 research workers.

INDUSTRY NEWS

URCLPWA Signs Goodyear; Strikes Others of Big Four

Negotiations which began on March 3 between the United Rubber, Cork, Linoleum & Plastic Workers of America, AFL-CIO, and the United States Rubber Co., and on March 10 between this union and the Firestone Tire & Rubber Co., The B. F. Goodrich Co., and Goodyear Tire & Rubber Co., have resulted in strikes at three of these companies, but not at the fourth. The URCLPWA struck U. S. Rubber on April 9 and Firestone and Goodrich on April 15; these dates are those for the expiration of existing contracts with the companies involved. Wages were not the subject at these negotiations; working conditions, pensions, insurance, severance pay, and supplemental unemployment benefit plans were.

An agreement between Goodyear and the union was reached on April 16, less than 15 hours after the union extended its talks with Goodyear beyond the April 15 deadline, but went ahead with strikes at Firestone and Goodrich.

Negotiations between the union and U. S. Rubber were resumed on April 14, between the union and Firestone and Goodrich on April 20.

The number of workers idled at U.S. Rubber was estimated at 23,700, at Firestone 17,000, and at Goodrich 13,500, for a total of more than 54,000 throughout the country.

Because three of the Big Four rubber companies remained struck on April 24, it appeared that there was some indication that the settlement with these companies would not be on the same basis as between the union and Goodyear and that the eventual agreements with U. S. Rubber, Firestone, and Goodrich would involve variations in basic labor contract terms between the Big Four rubber companies.

It was estimated that the Goodyear settlement with the union will cost the company about 5¢ per hour per worker.

Goodyear Tire & Rubber Co.

Goodyear in a statement under the date of April 20 announced that a new contract had been signed with the URCLPWA on that date which called for substantial improvements in pensions, insurance, working conditions, and supplemental unemployment benefits for some 23,000 hourly workers and their families.

Highlights of the pension and insurance agreement, which runs through April 30, 1964, are as follows:

Workers become eligible for normal retirement after 10 years of service at 65 years of age with pensions paid on the basis of about $2.50 per month for each year of service prior to January 1,

1959, as compared with the former $1.80 per month less Social Security benefits. No deductions for Social Security benefits are made with the new pension figuring system.

For those who have been on pension since 1949, benefits of not less than $2.25 per month for each year of service with no limit on the number of years worked are provided.

Disability benefits of about $5 per month for each year of service before January 1, 1959, and thereafter are provided.

Early retirement (after 20 years of service at age 55 at company request or mutual agreement) will provide about $5 per month for each year of service after 1959.

Medical coverage will now provide for liberalized benefits including in-hospital medical provisions and extra charges, upward adjustments in some surgical allowances, and there is a grievance procedure if a dispute arises over whether the proper benefit is provided.

Highlights of the company-wide working agreement, which runs through April 15, 1961, are as follows:

Liberalization of vacation requirements for those laid off or who leave the company; holiday pay changes; leave pay up to three days for funeral of mother-in-law or father-in-law; grievance procedure changes.

Each local union shall have the right to negotiate the skilled trades program at the local level; the company agreed to meet with local union representatives and International union representatives to discuss transfer of employes from a plant that is closing down to other plants.

In connection with supplemental unemployment benefits, which runs until April 15, 1961, the company, as in the past, pays 3¢ per hour into the fund for each hour an employe works. Based on a service formula, a laid-off employe can receive up to 65% of his pay, including State Unemployment Compensation.

U. S. Rubber Co.

In a statement issued at the beginning of the strike against 18 plants of U. S. Rubber Co., John W. McGovern, president of that company, pointed out that bargaining with the union had been done in good faith, and most serious consideration had been given to demands presented by the union. The company had offered 39 improvements in a liberalized contract, including increased disability pensions and increased minimum pensions, liberalized service rules, and other benefits, it was said.

In addition to the 39 improvements offered by the company, there are 58 other unresolved demands which are still at issue, the most important of which involves our fundamental right to manage the company with proper regard to sound employe relations, Mr. McGovern added.

In an accompanying statement by the industrial relations manager of U. S. Rubber to its employees it was pointed out that the union already had one of the best contracts to be found in industry. Working rules and benefits were said to be more liberal than those provided by most industrial contracts and better than those recently negotiated by the auto workers.

The company said it had offered to do a great deal during the negotiations, more than its profit record would indicate should have been offered. It cannot, if it wishes to remain competitive and solvent, agree to financial commitments beyond those already contracted for without endangering its security and that of its employes, it concluded.

Firestone Tire & Rubber Co.

A company spokesman for Firestone said on April 16 that the company had urged the union to continue the contract on a day-to-day basis which would have been in the best interests of the employes, the company, and its customers. In spite of this request and in spite of the numerous concessions made by the company, the union chose to strike.

The company said it understood that the strike action was taken after the union tentatively accepted from another company substantially the same terms it had offered and that company is without a strike.

Throughout the negotiations the company had made a sincere effort to meet the demands of the union, consistent with the right to run its factories on a sound economic basis in a highly competitive industry, it added.

B. F. Goodrich Co.

In a letter dated April 16 to its URCLPWA employes, Goodrich stated that the union had made impossible demands across the bargaining table which, if granted, would add more than a dollar an hour per employe to already high employment costs and would mean the end of business for the company and the end of jobs for B. F. Goodrich people.

The company added that practically nothing was settled before the strike deadline except those contract provisions in which the company conceded to the union's position. The union representatives showed no willingness to bargain; at the time of the deadline they made only minor changes in position on their original and impossible demands. At no time could the company detect any evidence of a sincere effort to settle, it was said.

In another letter dated April 17, Goodrich pointed out that there had been 12 major strikes in the rubber industry in 11 years and tried to explain what this meant to union employes.

Very little has been gained as the result of striking, it was said, although strike settlements have been widely publicized, and the final settlements are often presented as something won as a result of striking. In most cases almost all of the final settlement provisions were offered by the company involved before the strike was called. Additional provisions granted after a strike begins are comparatively small in relation to the total settlement, it was added.

Goodrich provided the accompanying table to illustrate the "striking price" paid by employes in wages alone during the past 12 years.

It was pointed out that the total amount lost in wages up to the 1959 strikes was nearly $44,000,000. Cost of lost wages to employes of the three companies in 1959 is still unknown.

Goodrich added that in addition to wages lost by employes, some business was lost to the company forever, and its reputation as a reliable supplier of quality products suffers further damage during strikes. No matter how strongly it feels about these facts, the company said it could not agree to a settlement which would undermine its business permanently, but wanted one which would be to the best interests of all concerned.

LEGAL STRIKES AGAINST MAJOR RUBBER COMPANIES, 1949-1959

Company	Year and Length of Strike	Employes Directly Affected	Estimated Wages Lost
Goodrich	1949 (35 days)	14,565	$4,147,000
Goodrich	1952 (12 days)	15,742	2,220,000
Goodrich	1957 (14 days)	14,244	2,955,000
Goodrich	1959 (? days)	*13,500	?
U. S. Rubber	1953 (4 days)	32,998	2,074,000
U. S. Rubber	1955 (8 days)	31,663	4,491,000
U. S. Rubber	1959 (? days)	*23,700	?
Firestone	1953 (3 days)	24,694	1,278,000
Firestone	1954 (18 days)	21,122	6,552,000
Firestone	1956 (12 days)	20,881	5,096,000
Firestone	1959 (? days)	*17,000	?
Goodyear	1954 (54 days)	23,867	15,136,000

*Approximate.

Ameripol Micro-Black Goes On Stream

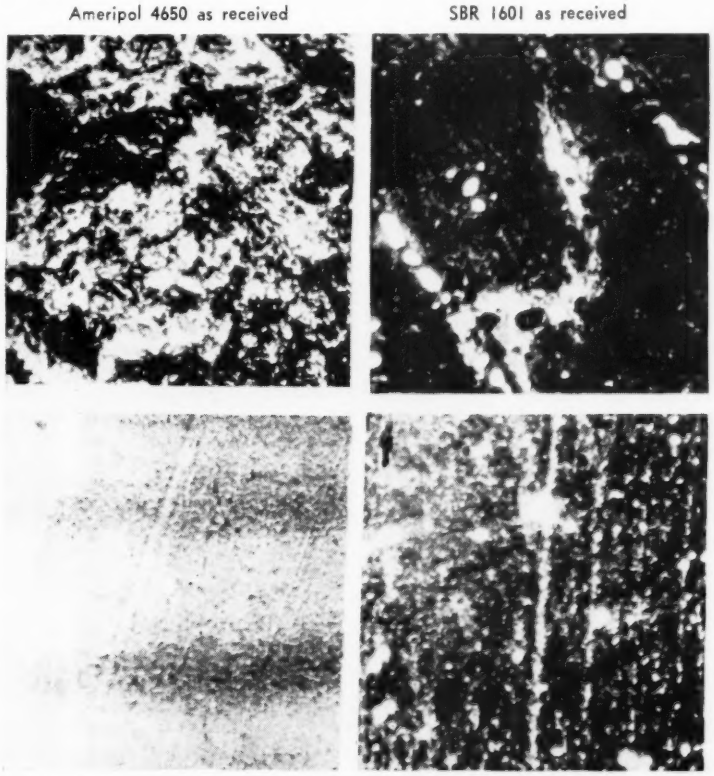
Facilities for large-volume production of a new SBR cold rubber containing carbon black intimately and uniformly mixed with rubber molecules by the mechanical process without dispersing agent, has been placed on stream by Goodrich-Gulf Chemicals, Inc., at its Port Neches, Tex., plant. Representing an investment of more than $1¼ million, the new equipment is designed to produce 15 million pounds of black masterbatch per month on a continuous-flow basis. Half of styrene-butadiene copolymer reactor lines, with their recovery and drying equipment, at the Fort Neches plant have been converted to this production.

The new product, designated Ameripol Micro-Black masterbatch, is reported to give as much as 15% more road life, when used as tire tread and retread stock, than present SBR rubbers when the carbon black is dry-mixed with the rubber in Banburys. Its improved abrasion resistance offers possibilities for belting, insulation, and molded and extruded products subjected to heavy-duty service, according to the firm.

A feature of the new installation is the handling equipment for the large amount of carbon black required for the operation. Delivered to the plant in railroad cars the black is discharged into a unique zipper belt conveyor manufactured by The B. F. Goodrich Co. The belt is automatically closed into a tube by rubber zippers as it leaves the unloading zone. The 500-foot-long belt moves the enclosed carbon black to storage silos. The carbon black is fed from the silos by screw conveyors to automatic measuring equipment that discharges it into special equipment for production of carbon black slurry after which it is hydraulically injected into a turbulent stream of latex rubber.

By the addition of a coagulant, a blending of the two components takes place instantaneously, and the carbon black is dispersed uniformly into the rubber. After this process, conventional filtering and drying procedures are carried out before the masterbatch is compressed into standard bales.

To maintain a strict control of product quality, Goodrich-Gulf has equipped a modern laboratory at Port Neches for sampling incoming raw materials, for checking the carbon black at slurry stage, and for testing the finished product. The company makes 13 different types of Ameripol Micro-Black masterbatch.



Photomicrographs show the uniform dispersion of carbon black into Ameripol 4650 by Goodrich-Gulf's new dispersion process, as compared to carbon black added by dry mixing

Canada's Synthetic Rubber Plant Closed

Polymer Corp., Ltd., the Canadian synthetic rubber plant has been out of production because of a strike of its local union of the Oil, Chemical & Atomic Workers since mid-March. As of late April, there was no indication of settlement of this strike.

Polymer Corp. made an offer of settlement on March 17, but the offer was rejected by the union. Polymer President E. R. Rowzee indicated a willingness in March to resume negotiations, but said that the March 17 offer was final. The union said in turn that there would have to be a change in the company's position before further negotiations would be undertaken.

The Polymer Corp. plant in Sarnia, Ont., Canada, normally employs about 1,850 persons. Meanwhile, work for another 1,500 Sarnia men at Dow Chemical of Canada, Ltd., Fiberglas of Canada, Ltd., and Cabot Carbon of Canada, Ltd., depends on the ability of Polymer Corp. to continue to supply steam to these adjoining plants. Imperial Oil, Ltd., which produced basic materials for Polymer, was forced to close.

Price competition and rising labor costs are said to have dropped Polymer Corp.'s earnings from $9.5 million in 1956 to $6.8 million in 1957, and Dr. Rowzee has said that certain changes required by the company are necessary to protect Polymer's ability to compete for world markets against strong competition.

Canadian rubber products manufacturers have had to obtain their synthetic rubber from the United States, and U. S. synthetic rubber producers have undoubtedly been supplying Polymer's customers abroad during this shutdown.

Dow Cuts Prices

Dow Corning Corp., Midland, Mich., has announced price reduction of its Antifoam B silicone defoamer ranging from 9-6¢ a pound, effective April 24. This new reduction, the second one within six months, brings the price of Antifoam B to 65¢ a pound in drum quantities. Antifoam B is a water dispersible silicone defoamer for aqueous systems which has proved to be an excellent means of killing foam in virtually all industries.

New Liquid Urethane Developed by Du Pont

A new liquid urethane elastomer, LD-213, that forms products with extreme hardness in combination with exceptional resistance to impact and abrasion, has been announced by E. I. du Pont de Nemours & Co., Inc., elastomer chemicals department. The new rubber is one of a family of urethane elastomers based on polytetramethylene ether glycol and Du Pont's "Hylene" organic isocyanates. The other developmental rubbers in the series—"Adiprene" L[1] and LD-167 urethane rubbers—have undergone testing and evaluation and are now in use in the rubber industry.

Like its predecessors, LD-213 is best compounded chemically, that is by adjustment of the glycol, isocyanates, and other essential ingredients in the course of polymerization and cross-linking, rather than by the physical methods used for conventional rubbers.

LD-213 yields unusually hard vulcanizates while still retaining significant elongation as well as properties which so nearly approach those of some plastic resins that it has been termed an "elasto-plastic." In properties, the new material is intermediate between hard rubbers and structural plastics such as nylon. Shore D hardness ranging upward from 50 to 80 combined with 250% elongation at break and very high impact resistance suggests that this new urethane rubber may find application in fields where plastics have not been adequate. Properties of representative formulations of the three types of urethane elastomer are given in the accompanying table.

As indicated above the tensile and tear strengths of LD-213 are high; impact resistance can run as high as 9-10 ft.lbs./in.; resistance to deformation is good, and flexural modulus is high. The material can be compounded to give very high energy absorption.

Oxygen and ozone appear to have little effect on these urethane elastomers, and resistance to radiation is good. LD-213 is not much affected by heat up to 250° F. and resists deterioration by most oils.

LD-213 can be processed as a liquid on the same commercially available equipment as Adiprenes L and LD-167.

Applications under investigation in which LD-213 shows promise include shock-resistant coatings, railroad-car draft gear, automotive ball joint bearings, gears, heel lifts, and large industrial tires. The two other types are already in commercial use for smaller industrial tires.

[1]RUBBER WORLD, Dec., 1958, p. 421.

Properties	Adiprene L	LD-167	LD-213
100% Modulus, psi.	1,000	1,900	3,500
Tensile strength, psi.	4,500	4,500	*7,500
Elongation at break, %	450	350	280
Hardness, Shore A	90	95	99
D	42	50	78
Tear strength, ppi., ASTM D 470	60	150	190
Compression set, %, ASTM D 575A (22 hrs./-70°C., 1350 psi.)	7	8	40
Flexural modulus, psi.	8,000	15,000	90,000
Impact resistance, notched Izod, ft.lbs./in.	F	F	6
Bureau of Standards abrasion index	175	275	380

* Pulled at one inch per minute instead of conventional 20 inches.

"Rubber Trends" Views USSR Rubber Industry

"Rubber Trends" is a new quarterly bulletin for rubber manufacturers, dealers, and producers and is available from The Economist Intelligence United, Ltd., 22 Ryder St., St. James's, London, S.W.1, England, or Warren S. Lockwood, Inc., 60 E. 42nd St., New York 17, N. Y., at £30, or $90, a year postpaid for the basic subscription. Additional subscription for the same organization will cost £5 or $15.

"Rubber Trends" is prepared and edited in London by EIU. Analysis and research are supplemented by reports from expert correspondents in the world's key producing and consuming areas. Trends in the United States are reported to EIU by Warren S. Lockwood, Inc.

Each quarterly issue will contain as regular features sections on World Balance, Trends in Consuming Countries, Market Reports, General Notes, and Statistics. There will be two special features in each issue also, which will be in the form of detailed reports on specific subjects such as trends in important rubber using industries, developments in rubber consumption in the Communist countries, technical developments likely to affect consumption, etc.

The March, 1959, issue of "Rubber Trends" consists of 46 pages. One of the special reports in this issue is concerned with "Russian Production and Consumption of Rubber"; the other with "The Prospects for United Kingdom Rubber Consumption."

Some comments from the features on Russian production and consumption may be of interest. For example, it is stated that although little is known of the actual scale of rubber consumption in the Soviet Union, judging by what is known of the current output of synthetic rubber and allowing for some addition to stocks of natural rubber, it would appear at present that consumption is of the order of 550,000 to 600,000 metric tons a year (one metric ton equals 0.98-long ton), about 70% of which may be synthetic rubber. There has been a rapid increase in rubber usage since 1950: tire production has increased from 5 to 14.4 million units in that period, and an output of 28 million units is planned by 1965. Production of rubber footwear in 1956, the last year for which figures are available, was 141.2 million pairs; while more than 6 million pairs are imported annually from Czechoslovakia and Bulgaria. Increasing industrialization will require more belts, hose, and insulated wire.

The first new large synthetic rubber plants will go into production in 1961, and by 1964 the total planned capacity of 1.5 million metric tons is expected to be reached. "Rubber Trends" expresses some doubt that this capacity will be reached by 1964, however, because of the amount of plant required for both the production of the rubber and the intermediates. Russian uncertainties about the future supply position of rubber seem to be emphasized both by the scale on which research is being conducted into the substitution of plastics for both natural and synthetic rubber and the eagerness of the Soviet authorities to develop their trade with Ceylon and Indonesia.

To Build Carbon Black Plant in Rotterdam

Continental Carbon Co. has announced plans to construct a carbon black plant at Rotterdam in the Netherlands, to cost approximately $2.5 million, which will have an initial annual capacity of 15,000 tons of high-abrasion carbon black. Construction on the plant will start immediately, with completion set for early 1960.

Continental Carbon Co. is owned by Continental Oil Co., Houston, Tex.; The Shamrock Oil & Gas Corp., Amarillo, Tex.; and Witco Chemical Co., New York, N. Y. It operates carbon black plants at Lake Charles, La., Ponca City, Okla., Sunray, Tex., and Eunice, N. M., and will own 50% of a carbon black installation to be built this year in France.

H. L. Woltersom, chairman of the Rotterdamsche Bank, has accepted the chairmanship of the new company. W. H. Thorbecke has been designated managing director for this operation.

Distribution of the products will be undertaken through the worldwide Witco marketing organization.

Cis-4 Now On-Stream

Phillips Petroleum Co., Bartlesville, Okla., which has reported success in severe tire tread road tests of its new *cis*-polybutadiene synthetic rubber, called Cis-4 (Phillips trademark), said that plant operation has been started to produce at a semi-commercial rate of more than one million pounds a year.

Quantities of the material suitable for large-scale market evaluation were available in April at a development price of $1.00 a pound. Phillips said that commercial production of the polymer is technically and economically feasible.

Continuation of tests has confirmed the original results which showed that Cis-4 alone, or in blends containing up to 50% of natural rubber, consistently outperformed natural rubber, according to Phillips. Cis-4 gave 30 to 40% longer tread wear, and, of even greater importance, it gave remarkably long tread wear in truck tires, with less heat generation than in natural rubber tires of corresponding sizes.

Litchfield Trusts

Paul W. Litchfield, honorary chairman of the board of The Goodyear Tire & Rubber Co., Akron, O., who died on March 18, established charitable trusts worth $1,050,000, according to the trustees of the funds. The trusts are separate from his estate. The trusts are the Paul W. Litchfield Charitable Trust of $650,000 and the Paul W. Litchfield Foundation of $400,000.

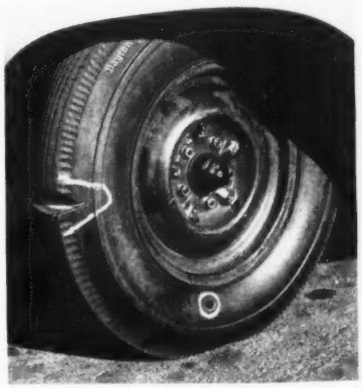
The Charitable Trust will be promptly distributed by the First National Bank of Akron, trustee, equally among the Children's Hospital of Akron; Boy Scouts of America, Akron Area Council; the University of Akron, to be added to its endowment fund; the Church of Our Saviour of Akron, to be added to its endowment fund; and Massachusetts Institute of Technology, Cambridge, Mass., from which Mr. Litchfield was graduated in 1896.

The charitable purposes of the $400,000 Foundation were not announced at this time.

New ESB-Reeves Firm

The Electric Storage Battery Co., Philadelphia, Pa., and Reeves Brothers, Inc., New York, N. Y., have formed a jointly owned corporation for the development of porous and microporous plastic materials for wearing apparel and other end-uses. The announcement was jointly made by C. F. Norberg, president of ESB, and John E. Reeves, president of Reeves Brothers.

The new firm, called the ESB-Reeves Corp., incorporated in Delaware, will utilize the technology of both ESB and Reeves Brothers, the latter through its Vulcan Rubber Products Division. ESB, a leader in the whole field of packaged power devices, has worked for some years in this area with materials applicable to batteries. Reeves Brothers, Inc., long a leader in the making of fine-quality textiles, has announced that developments are well advanced to apply microporous materials to such items as rainwear, infants' wear, coverings, military apparel, and sponge-type materials.



View of mutilated Dayton tire filled with Polyrubber which provided normal support and stability during following road tests

New Foam-Filled Tire By Dayton Rubber

A unique urethane-foam-filled tire developed by The Dayton Rubber Co., Dayton, O., may lead to a safe, blowout-proof, airless tire that would provide as comfortable a ride as conventional equipment. Initial tests performed on the experimental prototype, researched in Dayton's Freedlander Research & Development Laboratories, Hawthorne, Calif., indicated that the tire will not deflate even after extensive mutilation.

Filled with Polyrubber, a controlled density urethane foam of special formulation, the tire was drilled through the sidewall with a one-inch hole, then shot with a dozen high-powered rifle bullets. The tire was extensively road tested without any change in its riding qualities being apparent, according to Dayton Rubber.

Following this series of tests, a three-inch wide and deep wedge was cut across the tire and into the Polyrubber filling, which was reported to have remained intact without dissipation or protrusion during subsequent driving.

The Polyrubber is inserted into a Dayton tubeless tire forming a permanent bond with both casing and metal rim; its adhesion is as great as its cohesion. Repeated road tests with the foam-filled tires revealed greater stability and less lateral distortion during high-speed cornering, and better shock absorption without the reciprocal bouncing effect shown by air-filled tires, reported the rubber company.

There was no estimate when the new airless tire will be put on the market as the new Dayton tire will be further subjected to a complete series of developmental tests.

In another recent announcement, C. M. Christie, president of Dayton Rubber, predicted the availability of automobile tires molded from solid urethane without cords, plies, or expensive fabrication which will give greatly increased mileage at considerably lower cost. He spoke before the Chamber of Commerce of Springfield, Mo., the site of a new Dayton mechanical rubber goods plant now nearing completion.

Tires made from solid urethane will hold normal air pressure indefinitely because of the non-porous nature of the material, he stated. They will give at least twice the mileage of any conventional tire and will cost far less. Also, the material could be supplied in any color, custom blended to match the car's finish. Use of solid urethane as a long-wearing tread material is already under development, he concluded.

New Flooring Council

The Rubber and Vinyl Flooring Council has been formed as a subsidiary of the Rubber Manufacturers Association, Inc., according to C. P. McFadden, chairman of the flooring division of RMA. This Council is expected to expand the rubber flooring promotional program carried on by the RMA flooring division, and to sponsor joint promotion of solid rubber and vinyl flooring.

One objective of the program will be to clarify the meaning of solid vinyl as the highest quality vinyl flooring as differentiated from the various other types which are commonly called vinyl.

Members of the Rubber and Vinyl Flooring Council include: American Biltrite Rubber Co., Trenton, N. J.; Bonafide Mills, Inc., New York, N. Y.; The Danbury Rubber Co., Danbury, Conn.; The General Tire & Rubber Co., Akron, O.; Kentile, Inc., Brooklyn, N. Y.; The R.C.A. Rubber Co., Akron; Robbins Floor Products, Inc., Tuscumbia, Ala.; Vinyl Plastics, Inc., Sheboygan, Wis. The new Council will headquarter at 444 Madison Ave., New York, N. Y.

Industry News

NSC Contest Winners

The final results of the 1958 Rubber Section safety contest of the National Safety Council, Chicago, Ill., have been announced. Of the 163 contestants completing the annual contest, 31 of the plants had perfect records for 1958. The accident frequency rate is based on lost-time accidents per million manhours worked. First-place winners (many of these were ties), second place, and third-place winners in some cases, follow:

Division 1 (more than 400,000 manhours worked per month): United States Rubber Co.'s footwear plant, Naugatuck, Conn., first place; The Firestone Tire & Rubber Co.'s Brentford, England, plant, second place; and U. S. Rubber's Mishawaka, Ind., plant, third.

Division 2 (200,000 to 400,000 manhours per month): first place went to The Goodyear Tire & Rubber Co's Java, Indonesia, plant; second place, The Firestone Industrial Products Co.'s plant in Noblesville, Ind.; and third place to Firestone's plant in Bombay, India.

Division 3 (100,000 to 200,000 manhours per month): The following plants all won first-place awards in this division: Firestone's fuel cell division in Los Angeles, Calif.; U. S. Rubber's plant in Woonsocket, R. I.; Dominion Rubber Co., Ltd., mechanical goods division, Montreal, P.Q., Canada (a U. S. Rubber subsidiary).

Division 4 (50,000 to 100,000 manhours per month): 11 plants tied for first place in this division, including: U. S. Rubber, Washington, Ind.; American Synthetic Rubber, Louisville, Ky.; Goodyear, in Peru, S. A.; Firestone's plants in Manila, Philippines, and in Akron, O. (synthetic rubber plant); Stauffer Chemical Co.'s molded products division, Los Angeles, Calif.; U. S. Rubber's general research center and its Naugatuck Chemical Division, Naugatuck, Conn.; Duroflex, Inc., Buena Vista, Va.; B. F. Goodrich's sponge products plant 2, Shelton, Conn.; and Goodyear's plant in Wallasey, England.

Division 5 (under 50,000 manhours per month): here again a large number of plants won first-place awards, including: Corduroy Rubber Co., Grand Rapids, Mich.; General Shoe Corp., Nashville, Tenn.; U. S. Rubber plants at Santa Ana, Calif., and Sandy Hook, Conn. Goodrich's Riverside, N. J. and DuBois, Pa., plants; Goodyear's Muncie, Ind., plant; Flintkote Co., Whippany, N. J.; Canadian Lastex, Ltd., Montreal; Goodrich's sponge products plant 3; Firestone, Magnolia, Ark.; Rogers Corp., Willimantic, Conn.; Firestone's Akron retread plant and Los Angeles, Calif., industrial products plant; and Ideal Roller Mfg. Co., Chamblee, Ga.

The average frequency rates for the various divisions were as follows:

Division	Frequency Rate
1	1.69
2	2.81
3	2.87
4	5.20
5	7.60
All	2.77

Timken Offers To Buy British Timken Stock

The Timken Roller Bearing Co., Canton, O., recently offered to purchase for cash the ordinary shares of British Timken, Ltd., owned by minority holders at a price of £4.3.9d ($11.725) for each share. The American company presently owns 2,662,500 shares of the outstanding 5,000,000 ordinary shares of the British company.

The offer is conditional upon acceptance of not less than three-fourths in number of the holders of the 2,377,500 minority shares representing not less than 90% of the shares involved or such lesser proportion of the holders and lesser percentage of the minority shares as the American company shall determine. It is also subject to the appropriate consent by British Government authorities.

British Timken, Ltd., also has outstanding 1,000,000 4% cumulative redeemable preference shares of £1 each which will be redeemed if the offer as to the common shares is accepted.

The relation between the American and the British company was the subject of an anti-trust suit filed by the government in 1948. The final decision of the Supreme Court of the United States on appeal in that case was rendered in 1951 and the decision of the District Court (which had been adverse to Timken) was approved in part, but the American company was permitted to retain its stock in the British company.

The present program outlined above, eliminating the British corporate structure and combining the operations now handled by British Timken with those of the American company, has been discussed with the Department of Justice which has indicated no objection to the program.

The combination of the facilities of the two companies will make it possible for Timken to compete more effectively worldwide and will bring about cost savings in manufacture and eliminate needless duplication of sales, service, research, and development activities.

Plans New Test Track

Construction of what is said to be the world's largest tire testing track near Uvalde, Tex., has been started by The General Tire & Rubber Co., Akron, O. Designed by the firm's central engineering division, the 8½ mile track comprising a two-lane testing oval will be completed and available for tire tests by September 1.

A high-speed testing facility, the track will have one-mile radius turns and straightways of approximately one mile. Overall the track will be 44 feet wide on an eight-inch compacted base. The top surface will be rock asphalt.

The outer lane, designed principally for testing of automobile tires, will be banked to meet the speed requirements. The inner lane is designed for truck tire testing. The lanes will be enclosed by deerproof fence on both sides.

Future plans for the new testing site, which will be operated in addition to General Tire's present facilities in the San Antonio, Tex., area, include provisions for off-the-road and farm equipment tire tests.

Service facilities to be built at the Uvalde site include a 3,000-square-foot office building and an 8,000-square-foot garage for the truck and automobile fleet that will be operated there.

Letters to the Editor

(*Continued from page 174*)

I have had no experience with the stress relaxation technique used to evaluate network cleavage of polymers, but it is an interesting approach and appears to fall in line with the known characteristics of these polymers as we see them in our actual service experience.

R. T. LaPorte
Manager, Tire Research
and Compounding,
Seiberling Rubber Co.,
Akron, O.

This reader thinks our articles on statistical methods helpful.

April 22, 1959

Dear Sir:

I have read with considerable interest Professor Westcott's article on Frequency Distributions which appeared in the March, 1959, issue of Rubber World. In my opinion a series of articles on statistical techniques such as you contemplate is long overdue as a publication aimed at the rubber industry in general, and the rubber compounder in particular.

The average rubber compounder has, unfortunately, little conception of the use or value of even the simpler statistical concepts. The series of articles which you have begun should go a long way toward encouraging wide use of statistical techniques in our industry. You are to be congratulated for leading the way in this important field.

Edward F. Wood
United States Rubber Co.,
Passaic, N. J.

Each Witco-Continental plant represents years of experience and know-how in the production of furnace or channel black. Together, they insure carbon blacks of the highest quality, and suited to individual needs of each rubber goods manufacturer. **WITCO CHEMICAL COMPANY—CONTINENTAL CARBON COMPANY**

WITCO

Grades of rubber blacks produced by each of the Witco-Continental plants are:

EUNICE, N. MEXICO

Channel Blacks

Continental® AA-(EPC)
Continental A-(MPC)
Continental R-40-(CC)

Gas Furnace Blacks

Continex® SRF
Continex SRF-NS

WEST LAKE, LA.

Oil Furnace Blacks

Continex HAF
Continex CF

SUNRAY, TEXAS

Gas Furnace Blacks

Continex SRF
Continex SRF-NS
Continex HMF

Oil Furnace Blacks

Continex FEF
Continex GPF

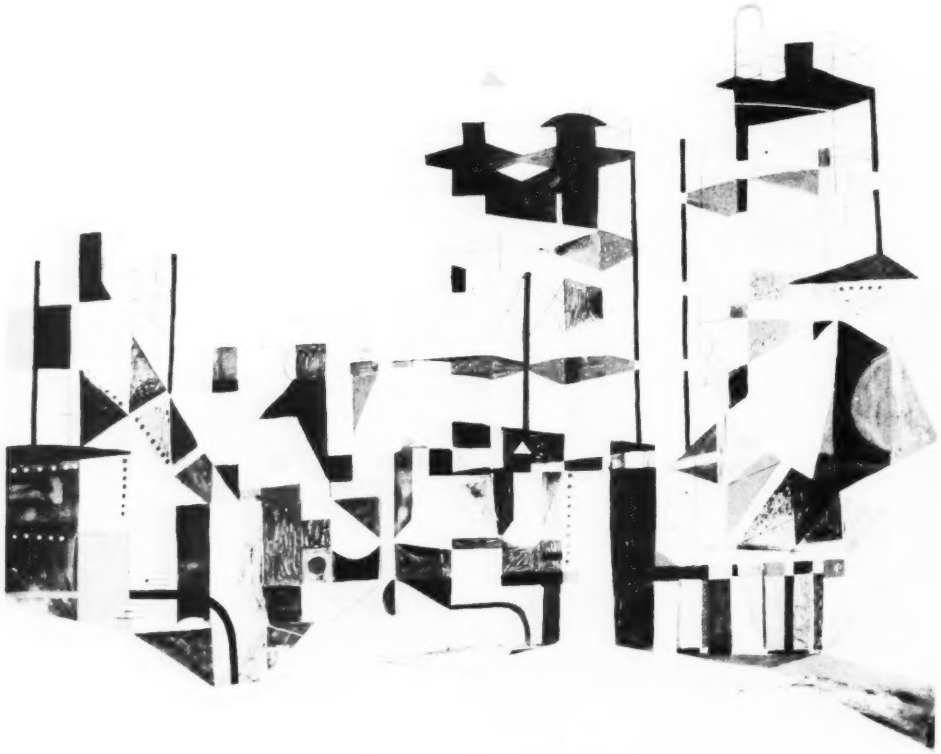
PONCA CITY, OKLA.

Oil Furnace Blacks

Continex HAF
Continex ISAF
Continex CF

Technical Service Laboratories at:

Akron, Ohio • Amarillo, Texas



WITCO CHEMICAL COMPANY, Inc. — CONTINENTAL CARBON COMPANY

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NEWS BRIEFS

PHILLIPS CHEMICAL CO. has begun the commercial production of dispersant-free cold SBR black masterbatches at its plant near Borger, Tex. The first of these masterbatches are Philprene 6661, which contains 52 parts of HAF black (Philblack 0) and 10 parts of highly aromatic oil (Philrich 5); and Philprene 6662, which contains 52 parts of ISAF black (Philblack I) and 12.5 parts of the same HA oil, all on 100 parts of SBR 1500. Plans are being made by Phillips to produce several other types of these masterbatches, it is said.

BELL TELEPHONE LABORATORIES plans building a $20-million modern laboratory at Holmdel, N. J., to meet the expanding need of research and development to advance communications. Bell Laboratories, the research and development organization for the Bell Telephone System, employs nearly 11,000 people at 18 locations in 10 states. The bulk of these employes are in New York, N. Y., and in Murray Hill and Whippany, N. J. The new building at the 430-acre site at Holmdel will be added to the buildings which presently house 150 scientists, engineers, and staff studying high-frequency radio and electronics. The present Holmdel laboratory has been the site of many historic communications developments, over the past three decades, in radio telephony and ultra-short wave propagation.

ARMSTRONG CORK CO.'S industrial division, Lancaster, Pa., has developed and is marketing a new plastic and ceramic wall-tile adhesive that allows up to 12 hours' working time. The new adhesive, called G-386, is a short, buttery, easy-spreading, white rubber-based composition that remains permanently elastic and rubbery and does not oxidize, bleed from joints, discolor, or become hard or brittle with age, it is claimed. Designed for installing polystyrene wall tiles or extruded polystyrene panels to smooth, clean, structurally sound wall surfaces, G-386 reacts chemically with the back of the plastic surface after prolonged contact to form an inseparable bond. This adhesive can also be used with excellent results for installing ceramic wall tile.

AMERICAN CYANAMID CO., Bound Brook, N. J., has developed a new ultra-violet absorber, called UV 314, for polyethylene and polypropylene for outdoor use which is expected to be available commercially next year. UV 314, 2,2'-dihydroxy-2-n-octoxybenzophenone, will be used initially in polyethylene fibers, films, and sheeting and is expected to increase annual polyethylene consumption as much as 10 to 50%. Polyethylene consumption in 1958 reached 832 million pounds. A similar impact on the polypropylene market is anticipated. UV 314 is a pale yellow powder that absorbs strongly in the 300-375 millimicron range of the ultra-violet. Its long alkyl group (n-octyl) at the ether linkage makes it compatible with polyolefins.

PHILLIPS ELECTRICAL CO., LTD., Brockville, Ont., Canada, manufacturer of electrical conductors since 1889, plans to establish a wire and cable plant in the Halifax area and has been negotiating with Industrial Estates, Ltd. The Halifax site in the Maritime Provinces will allow full advantage to be taken of low-cost water transport to bring in raw materials, and to allow the new plant to serve Phillips' established markets in South America and the Caribbean area. Phillips plans to manufacture all types of wire cable for which there is demand in the Atlantic provinces, together with those products required for the export market. These include bare and insulated copper and aluminum conductors for use in the power and telephone utilities and a complete line of building wire products.

THE FIRESTONE TIRE & RUBBER CO., Akron, O., recently awarded college scholarships to 27 high school seniors, sons and daughters of Firestone employes throughout the United States, according to Harvey S. Firestone, Jr., chairman and chief executive officer of the company. Full tuition, fees, textbooks, and a substantial contribution toward room and board are provided by each scholarship. They are renewable each year for a total of four years. Next fall a total of 101 young men and women will attend college under Firestone scholarships.

THE TEXAS- U. S. CHEMICAL CO. plans moving its executive-administrative headquarters from New York, N. Y., to Port Neches, Tex., tentatively scheduled for early June. The company's sales staff will continue to headquarter in New York from which it directs domestic and foreign sales of the company's Synpol SBR rubbers. The research and technical service laboratories will also be maintained in Parsippany, N. J. The company, jointly owned by The Texas Co. and United States Rubber Co., operates a large synthetic rubber plant in Port Neches and also has a half ownership in the world's largest butadiene plant there.

PLAX CORP., Hartford, Conn., has purchased from Shulton, Inc., Clifton, N. J., the exclusive rights to United States patent No. 2,811,468 and related worldwide patents for the fluorination of plastics. Fluorination of polyethylene containers, molded parts, and film is expected to be among the first applications. Plax has been investigating fluorination as a method for reducing the permeability of polyethylene and other thermoplastics. Though the process is not yet commercial, developments to date are said to be promising. The fluorination of polyethylene packages, as a supplement to present Plax commercial bottle linings, extends further the possibilities of marketing heretofore non-packagable products through extended shelf-life.

THE GOODYEAR TIRE & RUBBER CO.'S industrial products division has split its New York sales and service district into a New York district, north, and a New York district, metropolitan, according to J. W. Smith, eastern region manager for the division. H. L. Jinkerson has been named manager of the north district, and B. E. McClelland has been appointed manager of the metropolitan New York district. The move was made to increase service and sales efficiency in the area, which is increasing in importance and complexity as an automation center. Headquarters for both districts will be at Goodyear's office in New York, N. Y.

B. F. GOODRICH INDUSTRIAL PRODUCTS CO., Akron, O., has added wrist-band color codes, indicating glove sizes, to the Surgiderm line of surgeon's gloves recently introduced by its sundries division. Color-banded wrist construction supplements the original rolled-wrist style. The gloves are said to reduce hand fatigue by requiring up to 30% less energy to flex the fingers and hands than conventional surgeon's gloves. The gloves combine softness and comfort with strength and excellent aging qualities, according to BFG.

THE GENERAL TIRE & RUBBER CO., Akron, O., has announced that its new All Grip Traction tractor tire is constructed with Nygen cord, the first tractor tire to incorporate any kind of nylon construction. Featuring a radical double-curved cleat design, the new tire employs a unique age-resistant tread rubber. The tire's Nygen cord construction gives up to 50% greater resistance than conventionally constructed tires to bruise, furrow and impact breaks, and repels moisture and damp rot, according to General. The new tractor tire has been designed in all sizes for use on the latest extra-wide base rims.

THE GOODYEAR TIRE & RUBBER CO., Akron, O., will begin construction of a $7-million tire manufacturing plant in France as soon as plans can be completed, according to E. J. Thomas, chairman. The company is now studying site locations in France, and a decision is expected shortly as to the plant location. The new overseas plant will be the first such facility in France to be built and owned by an American tire manufacturer, reports Goodyear. The French facility will bring to 29 the number of overseas plants where Goodyear tires are manufactured, and to 58 the total number of Goodyear manufacturing operations worldwide.

B. F. GOODRICH INDUSTRIAL PRODUCTS CO., Akron, O., has developed a new line of boat slings which are said to combine strength with flexibility. Twelve-inch wide, five-ply rubber slings reinforced with nylon cord sold by Railey Milam, Inc., Miami Beach, Fla., and used by Miami Beach Boat Works, hoist 20,000 pounds, yet have none of the stiffness that can mar or damage woodwork, paint, or hardware. Slings are constructed like endless conveyor belts with two strands of a sling vulcanized to each other except for a loop left open at either end. BFG recommends the loop-built, nylon-cord construction because it provides excellent flexibility, high tear-resistance, and best resistance to mildew and the effects of salt water.

THE NINTH CANADIAN HIGH POLYMER FORUM will be held at the Guild Inn, Toronto, Ont., Canada, on October 26-28. The Forum, sponsored by the National Research Council of Canada in cooperation with the Chemical Institute of Canada, is devoted to all aspects of polymer science. General information concerning the Forum can be obtained by writing to Dr. M. H. Jones, chairman, Ninth Canadian High Polymer Forum, Ontario Research Foundation, 43 Queen's Park, Toronto 5, Ont., Canada.

THIOKOL CHEMICAL CORP., Trenton, N. J., discontinued its butyl rubber sales and service program, effective April 30. This action is based on the decision of Petroleum Chemicals, Inc., with which Thiokol Chemical Corp. has been associated in the development and expansion of markets for butyl rubber, not to construct a butyl rubber plant at this time. PCI feels that the estimated return on its investment is not attractive owing to the high cost of constructing the necessary facilities. Thiokol's butyl rubber salesmen will become part of its enlarged marketing group which will broaden its coverage of the rubber industry. After April 30, orders received by Thiokol will be forwarded to The Enjay Co. for processing.

IMPERIAL RUBBER MFG. CO., INC., Hackettstown, N. J., has acquired a new, modern, and larger plant with an annual production capacity of eight million pounds of tread rubber. Two No. 11 Banbury mixers and related equipment are being installed in the plant's 19,000 square feet of floor space. One mixer will be used exclusively for tread rubber; the other, for Imperial's new chemically cross-linked polyethylene compounds. James Cooke formerly managing director of the Cooke Color & Chemical Co., is directing the 25-year-old rubber company's expansion program. The new plant will have a daily capacity of 25,000 pounds of tread rubber and 25,000 pounds of polyethylene compounds.

COPOLYMER RUBBER & CHEMICAL CORP., Baton Rouge, La., recently increased its dry rubber production by adding a fifth line to its facilities which has twice the capacity of any one of the other four lines. The new line increases production capacity from 12,000,000 pounds gross per month to approximately 18,000,000 pounds gross per month. Also, R. F. Schultz has joined the company as director of research and development, effective March 1. He replaces P. G. Carpenter, now acting general manager of the plant.

CHAMPION RUBBER PRODUCTS CO., Los Angeles, Calif., is fabricating an electrically conductive silicone rubber part for use in a silicone electrode made by Tinker & Rasor Co., San Gabriel, Calif. The electrode is used as a detector in locating "holidays" or holes, leaks and bare spots in the films of protective coatings on equipment in which corrosive gases or liquids are transported or stored. The conductive rubber part of the electrode is made from Union Carbide K-1516 conductive silicone rubber compound, a material developed by silicones division, Union Carbide Corp.

UNION CARBIDE OLEFINS CO., division of Union Carbide Corp., New York, N. Y., is discontinuing the sale of solvent recovery plants, but will continue selling Columbia activated carbon for recovery purposes. Effective immediately, Columbia activated carbon solvent recovery plants previously designed and supplied by Union Carbide will be manufactured and sold by Vulcan-Cincinnati, Inc., engineer and constructor, of Cincinnati, O.

ENJAY CO., INC., New York, N. Y., reports that the use of butyl rubber in sealants for curtain wall construction has grown rapidly in the last few years. James F. Wernersbach, Enjay technical representative, speaking at the eighth annual meeting of the Building Research Institute on April 7 in Pittsburgh, attributed this growth to: (1) recent advances made in butyl technology and (2) a sincere desire on the part of sealant manufacturers to develop a practical, durable, and economical sealant for curtain walls. The wide variety of sealants includes inflatable, preformed, and composite gaskets; calking compounds for hidden and exposed joints; and tapes with fabric or cured rubber inserts.

THE GOODYEAR TIRE & RUBBER CO.'S packaging films department, Akron, O., predicted a 10% sales increase this year over those of 1958 for its packaging films. E. H. Dours, sales manager of the department, while speaking at the American Management Association's twenty-eighth National Packaging Exposition in Chicago, Ill., April 13-17, stated that first-quarter sales ran more than 15% ahead of sales in the corresponding period in 1958. Goodyear production facilities have been increased approximately 25% at both the Akron and St. Marys, O., film plants. Additional capacity for Videne will come this summer with volume operation of Goodyear's new $10 million chemical plant at Apple Grove, W. Va.

ABBEY PLASTICS CORP., Hudson, Mass., has developed an electrically conductive polyvinyl chloride compound, designated Abbey 100. The material, described as a semi-conductor, has an electrical volume resistivity of 11 ohms per centimeter cubed. It is commercially available for extrusion, calendering, and injection molding. Suggested uses include: replacement for copper braid in communications wire, semi-conductive electrical tape shielding on microphone cable, ignition-wire conductors and shielded wire for use on coaxial and high-voltage cables. Abbey 100 is compounded from Opalon vinyl resin supplied by Monsanto Chemical Co.

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HOOKER CHEMICAL CORP. plans to dedicate its new $3,800,000 research center on Grand Island, near Niagara Falls, N. Y., on June 2, with Governor Nelson A. Rockefeller as the key speaker at the formal ceremonies. Plans are being prepared to invite formally a considerable number of guests to the ceremonies on Dedication Day.

B. F. GOODRICH TIRE CO., a division of the B. F. Goodrich Co., plans to erect a modern, new distribution center at Evendale, a suburb of Cincinnati, O. A 52,000-square-foot office-warehouse will be built on a four-acre tract at 2929 Exon Ave., part of the Evendale Industrial Rail Sites, Inc., scheduled to be completed by the middle of October. In addition to warehousing the tire company's complete line of tires, the building will house the company's Cincinnati zone offices. It will serve large parts of Ohio, Indiana, Kentucky and West Virginia.

THE GOODYEAR TIRE & RUBBER CO., Akron, O., is offering a full service policy backing car owners who buy tires equipped with its Captive-Air Steel Cord Safety Shields, which are said to eliminate virtually the possibility of a flat tire. The shields are used on the company's Double Eagle, Custom Nylon Super Cushion, Blue Streak, and Suburbanite winter tires. The policy includes Goodyear's payment for road service, free replacement of the shield, and full allowance for unused tire mileage if the tire is damaged in service.

UBS CHEMICAL CORP., Cambridge, Mass., has broken ground for the construction of a pilot plant and laboratory in Marlboro, Mass., scheduled for completion in June. The new buildings, to be settled on part of an 18-acre site located in the Massachusetts Industrial Center, will house a polymer development laboratory and a small-scale production plant containing a multiple number of reactors and storage facilities. UBS is a leading manufacturer of polymer emulsions used by the floor finish, leather, and paper industries and in fabric backings and industrial adhesives.

IMPERIAL COLOR CHEMICAL & PAPER CORP., Glens Falls, N. Y., has been assigned United States patent No. 2,878,134, covering the product and process claims for the manufacture of a full range of mercury cadmium pigments, which Imperial has registered under the trade mark "Mercadium." The patent was issued to the company's L. J. Gagliano and J. E. Daly for the invention of new basic pigments with a wide variety of hues in the orange, red, and maroon ranges.

MONSANTO CHEMICAL CO., St. Louis, Mo., is now offering its delayed-action sulfenamide accelerators, Santocure and Santocure NS, in a new convenient briquette form in which the dry chemicals are pressed into miniature, pillow-shaped briquettes measuring only a half-inch in length and which was developed primarily for use in internal mixers. This new form is reported to be exceptionally free-flowing for maximum handling and weighing ease, both in automatic weighing machines and older types of equipment. The apparent density of these briquettes is estimated to be 20% lower than that of the powders.

ALLIED CHEMICAL CORP.'S plastics and coal chemicals division has announced completion of new phthalate ester plasticizer facilities at its Toledo, O., plant. The firm now offers its customers the advantage of a single basic source with varied plant and distributing locations capable of supplying its complete line of plasticizers.

B. F. GOODRICH INDUSTRIAL PRODUCTS CO., Akron, O., recently shipped its largest single belt, nearly six miles of rubber conveyor belting, destined for use on one of the world's longest permanent overland transport belt conveyor systems. The belting will be installed at the Ideal Cement Co. plant, Ada, Okla., to convey raw materials. One section of the system, nearly 12,000 feet long, requires a single rubber belt more than 4½ miles long, said to be longest single flight of belt ever engineered into such a conveyor system. BFG's Nyfil fabric, a combination of super-strength rayon with nylon filler, forms the internal reinforcement of the rubber belts.

THE C. P. HALL CO. OF LOS ANGELES has been appointed sales agent in five western states for Synpol SBR, produced by the Texas-U. S. Chemical Co. C. P. Hall has its main offices at 1340 E. 6th St., Los Angeles, Calif. It also has a warehouse at this location, and a second warehouse in Oakland, Calif., which services the Oakland-San Francisco area. In addition to California, it will handle sales of Synpol in Washington, Oregon, Utah, and Colorado.

RIPPLE SOLE CORP., Detroit, Mich., has announced that Denmark has granted trade mark registration for its Ripple sole. The Danish certificate of registration, No. 187-1959, gives protection covering footwear, and soles and heels, effective February 7, according to Leonard Hack, president of Ripple Sole.

THE B. F. GOODRICH CO., Akron, O., has donated gifts totaling $50,000 to five leading privately financed universities. Gifts of $10,000 each have been made to Harvard, Yale, Princeton, Cornell, and the University of Chicago, according to J. W. Keener, BFG president. BFG's aid to education program in 1958 totaled more than $120,000 in donations to United States universities, in addition to more than $160,000 of tax payments directly traceable to the support of publicly financed institutions of higher learning.

RUBATEX PRODUCTS, INC., has announced that its laboratory now is located at 48 Main St., Byfield, Mass., and its new phone number is HOmestead (Newburyport) 5-7418. The laboratory was previously at 27 Upham St., Melrose 76, Mass.

New showroom of Robbins Floor Products, Inc., at 515 Madison Ave., New York, N. Y., is an attractively coordinated display of all the firm's lines—vinyl, rubber, and cork tile. Floor installation features Byzantine, with matching feature strips, and Queen Anne patterns. Vignettes at left highlight Custom Cloud Pompeiian, first custom color line in smooth surface flooring. Sliding panels at right sample all Robbins patterns. Pillars display new vinyl mosaics.

News Briefs

THE GOODYEAR TIRE & RUBBER CO., Akron, O., has added Delco batteries to its automotive accessory line and will distribute them through its trade sales channels. The batteries, manufactured by the Delco-Remy division of General Motors Corp., will be merchandised in line with the company's policy of offering nationally known brands at the retail level. The batteries will be available through Goodyear outlets in most areas in the near future.

SEIBERLING RUBBER CO., Akron, O., has added a new lug-type truck tire, called the Trans-Rib, to its product line. The new tire, designed for heavy-duty highway service, was developed to keep pace with current trends to heavier freight shipments over the road, and larger, more powerful trucks. The Trans-Rib is built with nylon cord and has a wider tread than ordinary lug-type tires—a move to increase road contact, and mileage performance. Extra rubber has been added to the shoulder, Seiberling reports, a sensitive wearing area in tandem-axle operations.

THE UNITED STATES DEPARTMENT OF INTERIOR'S BUREAU OF MINES, Graphic Services, 4800 Forbes Ave., Pittsburgh 13, Pa., has available for free loan to any industry or professional group a new 16-mm. motion picture film in sound and color entitled "Rubber from Oil." The 30-minute film shows in historical perspective the discovery, testing, and production of butyl rubber and was sponsored by the Enjay Co., Inc., which paid all production costs and provided the necessary prints. The film begins with the portrayal of the work of two research chemists, who, seeking a substance for improving lubricating oil, created a compound that resembled natural rubber. The film also describes the preparation of new rubber at subzero temperatures and the development of the special reactors and the controls necessary to regulate the processes involved in the production of it. In communicating with the Department or the Bureau, refer to public notice number, P. N. 52317, of March 30, 1959.

ARMSTRONG CORK CO.'S industrial division, Lancaster, Pa., has formulated a new compound combining cork and silicone rubber. This new material, dubbed LC-800, for the first time combines the advantages of cork with silicone rubber. It allows the gasket designer to use cork and rubber gaskets at much higher temperatures than heretofore possible. LC-800, considerably less expensive than straight silicones, can be made in ribbons and lathe-cut rings, both extruded and laminated, as well as mats, sheets, and die-cut parts.

NATIONAL SAFETY COUNCIL, Chicago, Ill., has announced that three tire and rubber companies have received its Public Interest Award for exceptional service to safety in 1958. Brown's Tire Service, Lake City, Fla., the Firestone Tire & Rubber Co. and The B. F. Goodrich Co., both of Akron, O., were cited by the Council for furthering safety on radio , in newspaper and magazine advertisements, and through booklets. Howard Pyle, president of the Council, said that "one of the most inspiring things in public service work is the way business pitches in to help lick a threat to the people's welfare. The safety movement is tremendously grateful for the effective support of business advertising. It helped make possible a big reduction in the accident toll last year."

THE VINYL-METAL LAMINATORS INSTITUTE has joined forces with the Society of the Plastics Industry, Inc., New York, N. Y. The Institute, which has been in existence for two years and consists of seven companies which laminate vinyl film and sheeting to metal, will function as a division of SPI. Currently vinyl plastic film and sheeting are bonded to such metals as steel, magnesium, and aluminum. This combination of plastic and metal provides a new material for many types of products.

SOHIO CHEMICAL CO. has broken ground at Lima, O., for a multi-million-dollar petrochemical plant for the manufacture of acrylonitrile, based on a new process developed in the Sohio research center. A contract for engineering and construction of the new plant has been let to Badger Mfg. Co., Cambridge, Mass., and construction has begun, with the completion date scheduled for early in 1960. The plant is said to be the first commercial plant in the world to make acrylonitrile from propylene, ammonia, and air.

GENERAL ELECTRIC CO.'S silicone products department, Waterford, N. Y., is producing a new silicone grease designed as a rust inhibitor and lubricant for mated, threaded, or non-threaded ferrous components and fabricated rubber parts. Designated as SS-4007, it maintains its consistency from —75 to 300° F. and is serviceable in many applications where other products would either solidify or be subject to oxidation, evaporation or excessive bleed losses. Suggested applications include high- and low-temperature thread lubricant, corrosion preventative compound, and as a rubber lubricant for low and medium swelling components such as O-rings. SS-4007 meets the requirements of a new military specification for a lubricant and rust inhibitor, MIL-C-21567.

B. F. GOODRICH TIRE CO., Akron, O., has announced a new low-price front tire for farm and industrial tractors. Called the Dual Ring Front Tractor Tire, it is priced at about 20% less than the original-equipment tire while featuring the same tread depth and size as the latter. The new tire is said to offer better mileage and easier steering than previous tires of the same quality rating and the same carrying capacity as first-line tires. The new tire can be used on single front, wide front, row crop, and small industrial tractors. It is available in seven sizes: 5.00-15, 4.00-15, and 4.00-19, all four-ply; and 5.50-16 and 6.00-16 in both four- and six-ply.

THE GOODYEAR TIRE & RUBBER CO., Akron, O., has introduced a new, economical, non-fogging thermoplastic perforated film, designed specifically for in-store produce packaging. Called Pliofilm 75 PNF, the new wrap was one of Goodyear's featured products in its packaging films exhibit at the American Management Association's twenty-eighth National Packaging Exposition, which opened in Chicago, Ill., on April 13. The film was said to equal in price current competitive non-perforated produce materials.

RICHARDSON SCALE CO., Clifton, N. J., has moved its Philadelphia regional office to 11 Park Rd., Havertown, Pa. (Mailing address, P. O. Box 602). This office handles all Richardson business in Pennsylvania, Virginia, Maryland, and Delaware. Alan Farnham as been added to the Philadelphia office staff.

Adhesive Bond Theory

(*Continued from page 281*)

as he showed with slides.

Boundary layer weakness results from many causes, frequently entrapped air, moisture, and impurities in the adherends, or in the adhesive, that squeeze out of the latter to its surfaces. Proper cleaning of surfaces to be adhered, and purification of adhesive materials, make possible joints of strength almost as great as that calculated from the tensile strength of the adhesive.

Dr. Bikerman described purification of commercial polyethylenes and preparation of joints between steel and steel, steel and glass, and glass and glass that exhibited higher breaking stress than the tensile strength of the polyethylenes themselves. Such adhesionable polyethylenes have minor physical differences from the commercial materials, but take print much more easily and can be used as indicated above. The talk was concluded with a busy question period.

NEWS about PEOPLE

Alfred E. Raws, Jr., has been elected treasurer at a meeting of the board of directors of the Thiokol Chemical Corp., Trenton, N. J. Raws, formerly assistant treasurer, has been with the company since 1951.

Andrew R. Baumer has joined the staff of The B. F. Goodrich Co. Research Center, Brecksville, O., as a technical man in the physical research department. **Robert L. Marlowe** also joins the department as a technical man.

Harvey S. Firestone, Jr., has been elected national chairman of United Service Organizations, Inc., Washington, D. C., for the ninth straight year, at the annual meeting of the USO National Council recently held in Washington. President Eisenhower, honorary chairman of USO, extended his greetings to the officers and members of the council.

Virgil C. McQuiddy, Jr., has been named general sales manager of the textile division, United States Rubber Co., New York, N. Y. He replaces **W. D. Johnson,** who has retired to go into private business in Fairfield County, Conn. McQuiddy, formerly textile products sales manager, in his new position will direct sales activities for a variety of consumer and industrial textile products. Among the industrial products under his direction are rayon and nylon tire cord, hose and conveyor belt ducks, asbestos fabrics and tapes, chafer and filter fabrics, and fuel cell fabrics. Textile products which end up in consumer products include Lastex yarns, Trilok three-dimensional upholstery fabrics, cotton rayon, nylon and blended knitting yarns, and combed yarns of various types.

Walter J. Roider, Jr., has been named general manager of the Borden Chemical Co.'s international department, New York, N. Y., according to **J. J. O'Connor,** vice president in charge of foreign operations. Roider, who will retain his present responsibilities as general manager of the casein and special products department, succeeds **Parker B. Smith,** who resigned March 31.

Raymond F. Schultz has joined Copolymer Rubber & Chemical Corp., Baton Rouge, La., as director of research and development. Dr. Schultz was associated with Hercules Powder Co. since 1941, where he had served as director of the research center, a member of the administrative research department, and as special assistant to the research director. From 1934 to 1937 he worked for Du Pont as a member of the ammonia department, with interest in high-pressure synthetic methods. Prior to that he had carried out research at Lehigh University on chemical equilibria, reactions of aromatic compounds, and applications of resins.

James A. Singmaster has been appointed a member of the corporate planning group of Monsanto Chemical Co., St. Louis, Mo., according to **Charles Allen Thomas,** president. Singmaster, who will join the group on June 1, had been eastern regional sales manager for Monsanto's organic chemicals division. The planning group assists the company's executive committee in the appraisal of appropriation forecasts, in coordination and consolidation of long-range plans, and in strengthening and improving mechanisms and techniques of control.

Robert T. Daily has been appointed manager of marketing for the silicone products department, General Electric Co., Waterford, N. Y. He succeeds **Jerome T. Coe**, named department general manager in February. Most recently serving as manager of rubber market development for the silicone products department, Daily has been associated with G-E silicone operations since 1954.

Henry B. Puff has been appointed assistant production manager-resins for the Durez Plastics Division, Hooker Chemical Corp., North Tonawanda, N. Y. **Edwin E. Woodman** has been made district sales manager of the Chicago, Ill., office of the division, succeeding Puff, who was district sales manager there since July, 1956. Woodman was a Durez salesman in the Chicago district for more than 20 years.

William O. Blesse has been appointed superintendent of operations at Witco Chemical Co.'s new phthalic anhydride plant in Chicago, Ill. The new plant will utilize a naphthalene oxidation process to produce high-grade phthalic anhydride, with full-scale operations scheduled for the immediate future.

D. H. Gordon has been appointed vice president—auxiliary staff departments, Dominion Rubber Co., Ltd., Montreal, P.Q., Canada, according to **C. C. Thackray,** president. In his new capacity, Gordon will be responsible for the direction of staff departments: central engineering management engineering; distributing branches; advertising; operations research; and traffic.

H. G. Harper, vice president in charge of sales of the Goodyear Tire & Rubber Co. of Canada, Ltd., New Toronto, Ont., Canada, has announced that all sales functions are now grouped into five divisions with managers reporting directly to him. **C. B. Cooper,** formerly general sales manager, becomes assistant to Harper.
G. F. Turner has been appointed manager, tire marketing division, with marketing responsibility for tires, batteries, accessories, retread and repair materials, service and adjustments, sales statistics, and sales training. **W. R. Ecclestone** is now manager, tire sales division. The manufacturers' sales division, under **A. E. Grainger,** has responsibility for all sales of original equipment to automobile manufacturers. The advertising department, under **A. E. Ross,** is responsible for advertising and sales promotion of all products.

Ralph Reiter becomes head of the elastomeric section of Resin Research Laboratories, Newark, N. J. With eight years of extensive research experience in high heat-resistant resins and polymers, he will supervise all contracted research projects in the rubber, latex, and foam rubber fields.

Pierre Gyss, head of the chemical department of Socfin, Co., Ltd., *Hevea* latex and rubber producer in Malaya, recently spent three weeks in the United States and Canada visiting the technical departments of users of Soctex latex and Socfin rubbers. On his return trip to Malaya, Dr. Gyss will go via Cambodia and South Viet Nam to visit sister companies of Socfin which produce Terres Rouges rubbers and latices. Dr. Gyss visited America to gather data to improve existing latices and rubbers and also to compare notes for the further development and utilization of new latices being worked on in the Far Eastern Laboratories and estates. In particular, the low ammonia latices were extensively investigated.

Elmer F. Myers has been appointed assistant district manager of the Akron, O., territory for Farrel-Birmingham Co., Inc., headquartering at 665 W. Market St., Akron. He has been with the company since 1946. **Stanley J. Budzik** succeeds Myers in the Southeast territory, with headquarters at 710 Peachtree St., N. E., Atlanta 8, Ga. For the past three years he has specialized in the sale of Farrel roll grinders.

Travis W. Brasfield has been appointed commodity sales manager for Kralastic, a tough and corrosion-resistant blend of rubber and plastic, for the Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn. Brasfield succeeds **Arthur K. O'Keefe,** recently elected president of the Texas-U. S. Chemical Co. In his new assignment, Brasfield will coordinate sales, development, and promotion of Kralastic.

William F. Coulter, director of automotive sales for Rubbermaid, Inc., Wooster, O., has assumed the additional responsibility for direction of the company's marine (boating accessories) division. The move was made because marine sales more closely parallel automotive sales and channels of distribution through manufacturers' representatives. Also, greater national field coverage will be gained without the addition of personnel.

S. J. Budzik

E. F. Myers

G. C. Clark

W. H. Thorbecke

R. C. Springborn

Robert W. Wert

E. H. Gibbs, newly appointed manager of tire development and research, Seiberling Rubber Co., Akron, O., has announced the following changes as part of the company's new products program: **Reed L. Schild,** chief tire compounder, becomes chief chemist; **Sam I. Roudebush,** who was special production coordinator, is now manager of tire research; **Vernon E. Musser,** formerly tire design engineer, has been made chief technical service engineer. Also, **A. B. Gill,** fabric technologist, becomes manager of fabric development; and **Glenn R. Westenbarger,** formerly development compounder, has been named chief service compounder.

Ed. J. Lynch has been appointed sales representative for Davis-Standard, division of Franklin Research Corp., Mystic, Conn. He will handle the complete line of D-S thermoplastic extruders and wire line machinery in California, Oregon, and Washington. His address is P. O. Box 3043, Santa Ana, Calif.

Homer C. Wilson has been appointed to the newly created position of manager of operations of Texas Butadiene & Chemical Corp., with headquarters at the Houston, Tex., office. Since joining the company in 1956, he has been director of supplies. Previously he was manager of the Petrocel division of Celanese Corp., at Corpus Christi.

J. H. Saunders now is director of research for Mobay Chemical Co., Pittsburgh, Pa. He succeeds **E. E. Hardy,** who has accepted a position with Monsanto Chemical Co.'s plastics division in Springfield, Mass.

Grover C. Clark has been named supervisor of tire merchandising for the Chemstrand Corp., New York, N. Y. He was with The B. F. Goodrich Co. for the past 19 years, 11 of which were with the associated tire accessories division, where his most recent position was manager, merchandising and oil company sales. In his new position he will supervise the accelerated Chemstrand nylon tire cord merchandising program from the company's Akron district office.

William H. Thorbecke has been elected vice president-international division, by the board of directors of Witco Chemical Co., New York, N. Y. In addition to these new responsibilities, he continues as manager of the international division of Continental Carbon Co., a Witco affiliate. Previous to joining Continental, he was manager of the plastics and resins department of Shell Petroleum Co., Ltd., the parent operating company of the Royal-Dutch Shell Group of companies.

R. C. Berkinshaw, president and general manager since 1952, has been elected chairman of the board of The Goodyear Tire & Rubber Co. of Canada, Ltd., New Toronto, Ont., Canada, and **L. E. Spencer** has been elected president and general manager. Spencer was executive vice president of the company since March, 1958.

J. W. Selden becomes general manager, chemical division, Minnesota Mining & Mfg. Co., St. Paul, Minn. Selden, assistant general manager of the division since 1955, succeeds **B. J. Oakes,** 3M vice president retiring after 31 years of service with the company.

Robert C. Springborn has joined Marbon Chemical Division, Borg-Warner Corp., as manager of research. Dr. Springborn will be located at the new research facilities, which are part of Marbon's recently completed $10-million plant in Washington, W. Va. Prior to joining Marbon, he was associated with Monsanto Chemical Co., and the Gillette Co.

Robert W. Wert becomes field representative for chemical distributor operations for the Mineral & Chemicals Corp. of America, Menlo Park, N. J. This appointment will further expand the services available to distributors and their customers, according to **O. E. Hempel,** manager of chemical distributor operations.

Richard K. Opper has been named reclaimed rubber commodity manager for the Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn. Opper, with U. S. Rubber since 1929, was formerly sales manager of Synpol synthetic rubber. Synpol rubbers are produced by Texas-U. S. Chemical Co., jointly owned by U. S. Rubber and The Texas Co., and until early this year the domestic sales of Synpol were handled by Naugatuck. In his new post, Opper will direct a marketing program for reclaimed rubber and will coordinate sales, advertising, promotion, and development projects.

J. Robert Swenson becomes plant engineer, and **B. C. McConnell** becomes chief chemist of the Firestone Synthetic Rubber & Latex Co. plant in Akron, O., according to **C. A. Hill,** production manager of the plant.

Russell J. Stuebing has joined the sales staff of Whittaker, Clark & Daniels, Inc., New York, N. Y., as representative for products distributed to the paint and rubber industries. Stuebing is well qualified to serve these industries by virtue of his previous association with such companies as C. K. Williams, Sherwin Williams Co., and Krumbhaar Chemicals, Inc.

Hugh L. Hayward has been made manager of the dealer department, The Goodyear Tire & Rubber Co., Akron, O., and will concentrate on coordinating activities of Goodyear's vast network of dealers throughout the United States.

Howard K. Norris has been named production manager of the mechanical goods division of United States Rubber Co., New York, N. Y. He succeeds **W. A. Armstrong,** production manager of the division since 1949, who retired at the age of 60. Norris, headquartering in New York, will supervise plant production and product development at the Philadelphia, Pa., Passaic, N. J., and Sandy Hook, Conn., plants of U. S. Rubber. Starting with the company's tire sales department in 1940, he moved into purchasing in 1942 as part of a team under government contract. In 1945 he joined the mechanical goods division at the Gilmer plant in Tacony, Philadelphia. He was transferred to the firm's Passaic plant in 1952 as administrative assistant to the factory manager. He returned to Gilmer in 1953 as assistant factory manager and became factory manager in 1957, the post he held until his most recent promotion.

Samuel A. Wolpert has been made market analyst for Industrial Rayon Corp., Cleveland, O. Previously he held the position of administrative assistant.

George L. Fetherolf is now manager of automotive Pliotrim sales, engineered products department, The Goodyear Tire & Rubber Co., Akron, O. Also, **John M. Washburn** has been named manager of Airfoam sales, engineered products department. He succeeds **Anthony W. Webner II,** recently appointed Goodyear's director of racing.

James B. Braden has been appointed assistant manager for sales development of United Carbon Co., Inc., headquartering in Akron, O. He will serve as sales technical service representative from United Carbon's new laboratory there. During the past five years he was factory manager for Dryden Rubber Division of Sheller Mfg. Corp., Montpelier, Ind., and earlier had been chief chemist for Industrial Rubber Goods Co., St. Joseph, Mich.

Morrison M. Bump has been named director of marketing for United Carbon Co. and vice president of its subsidiary, United Carbon Co., Inc., Charleston, W. Va., according to **R. W. French,** president. Bump resigned as president of the Union Paste Co., Hyde Park, Mass., to accept the post. Associated with Union Paste for the past 19 years, Bump was in charge of the company's marketing for 12 years before becoming its president in 1957.

J. E. Gulick, vice president-manufacturing of B. F. Goodrich Tire Co., a division of The B. F. Goodrich Co., Akron, O., retired April 1 after 32 years with the company. He is succeeded by **Walter E. Head.** Gulick joined BFG in 1927 as a tire development engineer and from 1934 to 1937 was manager of the company's Canadian plant at Kitchener, Ont. During 1939 and 1940 he surveyed plants of European and South American companies associated with BFG. He became general manager of tire manufacturing in 1946 and vice president-manufacturing in June, 1953. Head was appointed manager of the newly built Miami, Okla., plant in 1954 and held that position until returning to Akron as manager of manufacturing in 1957.

Eugene F. Warren has been named assistant to **Arthur Schubert,** executive vice president of Emery Industries, Inc., Cincinnati, O., according to **John J. Emery,** president. Warren will handle special assignments in connection with the chemical firm's expansion program, including foreign market operations.

Talmage W. Cobb has been appointed sales representative for the Greenville, S. C., territory of Harwick Standard Chemical Co. He will headquarter in Greenville, P. O. Box 746, and will handle accounts in North Carolina, South Carolina, Florida, eastern Tennessee, and eastern Georgia. The telephone number of Harwick's office and warehouse facilities in Greenville is Cedar 5-0871.

Pach Bros., N.Y.

H. K. Norris

Madison Geddes

K. Greene

J. B. Braden

M. M. Bump

Coxe Studio

T. W. Cobb

Pach Bros., N. Y.

R. A. All

Kendall Greene has been appointed director of economics and planning of Goodrich-Gulf Chemicals, Inc., Cleveland, O. He joins the company following nearly eight years with Gulf Oil Corp., where he served as director of commercial research, petrochemicals. While employed by Gulf, his work included extensive economic and market research studies concerning synthetic rubber. In his new assignment he will direct economic and market studies concerned with current operations and future developments.

Donald J. McIntyre has been made manager of the northern division of American Mineral Spirits Co., with office and storage terminal facilities at 40 E. Water St., St. Paul, Minn. As manager, he succeeds **Clyde C. McInnes,** who died recently following a prolonged illness. McIntyre joined Amsco six years ago as a technical representative in the New York and New Jersey area. In 1955 he was promoted to manager of Amsco's new sales office and storage terminal at Baltimore, Md.

Raymond A. All has been named to the newly created post of director of marketing for the textile division, United States Rubber Co., New York, N. Y. He will have overall responsibility for long-range planning, merchandising, sales, market development, advertising, and sales promotion for one of the 15 largest textile producers in the nation, operating 10 mills in five southern states. Prior to joining U. S. Rubber at its Hogansville, Ga., mills, he was employed by the Callaway Mills in LaGrange, Ga.

News about People

John Andrews is now assistant director of foreign operations of Godfrey L. Cabot, Inc., Boston, Mass., according to **D. D. Cochrane,** vice president in charge of foreign operations. Andrews will assume his new duties as of August 1, with headquarters in Boston. After a six-year assignment overseas, he returns from France where he served as president and managing director of Cabot France, S.A., as well as directing other Cabot affairs on the European continent from September, 1955, to the present.

E. J. Fredericks and **L. E. Gigax** have been elected vice presidents to head sales and manufacturing operations, respectively, of Rubbermaid, Inc., Wooster, O. Fredericks, as vice president in charge of sales and marketing, will be responsible for sales, marketing, and merchandising programs and personnel. Gigax, who has been factory manager, becomes vice president in charge of manufacturing, with responsibility for all factory and production operations.

John R. Stanley has been appointed sales manager for Resinite garden hose products of the Borden Chemical Co., New York, N. Y., according to **James A. Wold,** general manager of the company's consumer products department. Stanley will be responsible for garden hose and sprinkler sales in three Borden sales areas representing a territory from the Gulf of Mexico to the Canadian border and east of the Rockies.

William H. Onderdonk has been named factory manager of the Gilmer plant, United States Rubber Co. The plant, located in Tacony, Philadelphia, Pa., is manufacturing and sales headquarters for the rubber company's diverse line of power transmission products. Most recently, Onderdonk was divisional superintendent of the hose department, a post he had held since 1953, at Passaic, N. J.

Joseph C. Nelson, Jr., now is assistant sales manager of the calcium products division, The Georgia Marble Co., Tate, Ga. **James R. Thornwell** and **Thomas E. Evans** have been appointed sales representatives of the division; and **Al Boehmer, Jr.,** former sales representative, has resigned.

Emerson C. Jones becomes manager of technical service for polyvinyl chloride resins and compounds, according to **Robert F. Hill,** sales manager of the Eleonora chemical division of The Pantasote Co., Passaic, N. J. Prior to joining Pantasote, Jones was associated with Essex Wire Corp. as a thermoplastics wire and cable engineer.

Warren E. Jones has been named factory manager of Firestone Synthetic Rubber & Latex Co.'s Akron, O., synthetic rubber plant. Also, the responsibilities of **Robert J. Easton,** production manager, have been broadened, and **J. P. Gorey** has been promoted to the position of technical manager of the plant. Jones was manager of technical sales since 1955.

H. E. Buecken

W. E. Jones

Hans E. Buecken has established his own business in Los Angeles, Calif., as manufacturer's representative and extrusion engineering consultant, under the name of Hans E. Buecken Co. Buecken, formerly assistant vice president of the extruder division, National Rubber Machinery Co., announces that NRM is his first and also most important account in this new venture, and he will promote NRM rubber and plastics extruder sales in California, Washington, Oregon, Arizona, and Nevada.

Joseph A. Valle has been promoted to the position of field representative for the Republic Rubber Division, Lee Rubber & Tire Corp., headquartering in Philadelphia, Pa. Valle will be responsible for the sales and service of Republic's hose, belting, and packing to the industrial users of Philadelphia and the surrounding areas.

J. B. Prendergast has been appointed president and general manager by the board of directors of Gutta Percha & Rubber, Ltd., Toronto, Ont., Canada. **M. O. Simpson, Jr.,** president since 1956, has been named chairman, enabling him to assume broader responsibilities with the parent company, Combined Enterprises, Ltd. Prior to his recent appointment, Prendergast was vice president, marketing.

Henry D. Wright has been elected president of Schenectady Varnish Co., Inc., Schenectady, N. Y., succeeding his father, the late **W. Howard Wright,** who founded the firm and was its president since 1906. Other officers, whose appointments were announced at the same time, were **Clinton A. Braidwood,** vice president, and **George B. Tod,** treasurer. Tod was also elected a director of the concern.

Albert S. Ault, president of Chicago Vitreous Corp. division of The Eagle-Picher Co., Cincinnati, O., was selected a vice president of the parent company at a recent annual meeting of the shareholders. **John C. Heisler,** formerly assistant treasurer of Eagle-Picher, was elected treasurer. **Melvin S. Chubb,** manager of the couples department of the chemical division, was elected assistant secretary.

Theodore D. Trowbridge has joined the applied research section of the new products research department, Godfrey L. Cabot, Inc., Boston, Mass., carbon black and chemicals manufacturing firm.

Ralph O. Williams joins the sales staff of A. Gross & Co., New York, N. Y., manufacturer of fatty acids and glycerides. With headquarters at Charlotte, N. C., he will handle sales and technical service for the company in North and South Carolina, Virginia, and eastern Tennessee.

Theodore I. Veiock has been appointed to the newly created post of assistant to the president of Lee Rubber & Tire Corp., Conshohocken, Pa., according to **A. A. Garthwaite, Jr.,** president. Veiock, a tire production specialist, was formerly with the Firestone Tire & Rubber Co.

Clark C. Sorensen has joined Hooker Chemical Corp., Niagara Falls, N. Y., as director of public and personnel relations. He will administer both public and industrial relations according to policies established by **R. Wolcott Hooker** and **Frank W. Dennis,** senior vice presidents. **Thomas H. Trimble** will continue, however, in his present capacity, that of manager of public relations.

Lee Turhune has been named assistant development manager at the Borden Chemical Co.'s Resinite department plant in North Andover, Mass., according to **James A. Wold,** general manager of Borden's Resinite operations.

G. T. E. Graham has been appointed inventors' representative for United States Rubber Co., succeeding **R. K. Kuhns,** resigned. Dr. Graham, a member of the patent and information department at the company's research center in Wayne, N. J., will screen and process ideas, inventions, and patents submitted to the company. He, or his alternate, **O. E. Beckvold,** will be available for inventors' representative contacts at the company's Rockefeller Center headquarters in New York, N. Y., on Tuesdays and Thursdays.

ROLLING with the PUNCH!

This sole is ROLLING WITH THE PUNCH. It is filled with nitrogen gas. This gas originates from OPEX 40 . . National Polychemicals nitrogen releasing blowing agent.

The introduction of nitrogen into your rubber soling will increase the buoyancy of the sole and literally put the "spring into the step." Nitrogen will give your sole excellent resistance to abrasion . . . cushioning the normal, every day "blows" from the walking surface.

Besides OPEX 40, our low cost nitrosoamine blowing agent, we also offer KEMPORE R-125, an aliphatic hydrazine derivative which produces odorless, nitrogen-filled sponge for soling . . . or other uses.

Call upon National Polychemicals for further information on this principle. Our "know-how", particularly in the soling field, can be put to work for you. We can save you money, improve your product and have your customers "walking on air."

NATIONAL POLYCHEMICALS, INC.

Wilmington, Massachusetts

NEWS from ABROAD

Russian Synthetic Rubber Details

Recent reports from Russia emphasize the massive industrial expansion planned for the seven-year period to 1965 in which petrochemicals, chiefly for the synthetic rubber, plastics, and synthetic fiber industries, are to play an important part. Hitherto chemicals for these industries have been based chiefly on coal and agricultural products (for alcohol and acids). But now intensive exploitation is to be undertaken of the large oil and natural gas resources said to have been discovered in the Uzbekistan region in southern Siberia, and territories farther east, to further the ambitious chemical schemes for Soviet Russia and the satellite countries; pipe lines are to carry oil and gas to East Germany, for instance.

Commercial Rubbers

The commercial production of synthetic rubber in Russia seems to go back to 1932, when a factory at Jaroslawl went into operation, using butadiene from alcohol. What the present production of synthetic rubber is in Russia cannot be more than estimated, since the Soviet does not believe in releasing regular statistics; it is suggested by one source[1] that the figure in 1958 was about 460,000 metric tons (450,800 long tons). More information, however, is available on the types of rubber produced on commercial or experimental scales.

An informative article[2] by R. Ulbrich, of the German Plastics Institute, Darmstadt, describes Russian rubbers and gives a list of the best known types, which we reproduce below in modified form. .

From the article it is learned that the SKMS rubbers, copolymers of butadiene and α-methyl styrene, are made only in Russia, and that the reason for producing them is that large amounts of propylene are available for making isopropylene from which the α-methyl styrene is derived. Dr. Ulbrich gives details of the three-stage method of producing monomeric methyl styrene and for the polymerization process. In the latter connection he refers to recent work by G. G. Lowry[3] on a polymerization process involving photo-initiation and gamma irradiation.

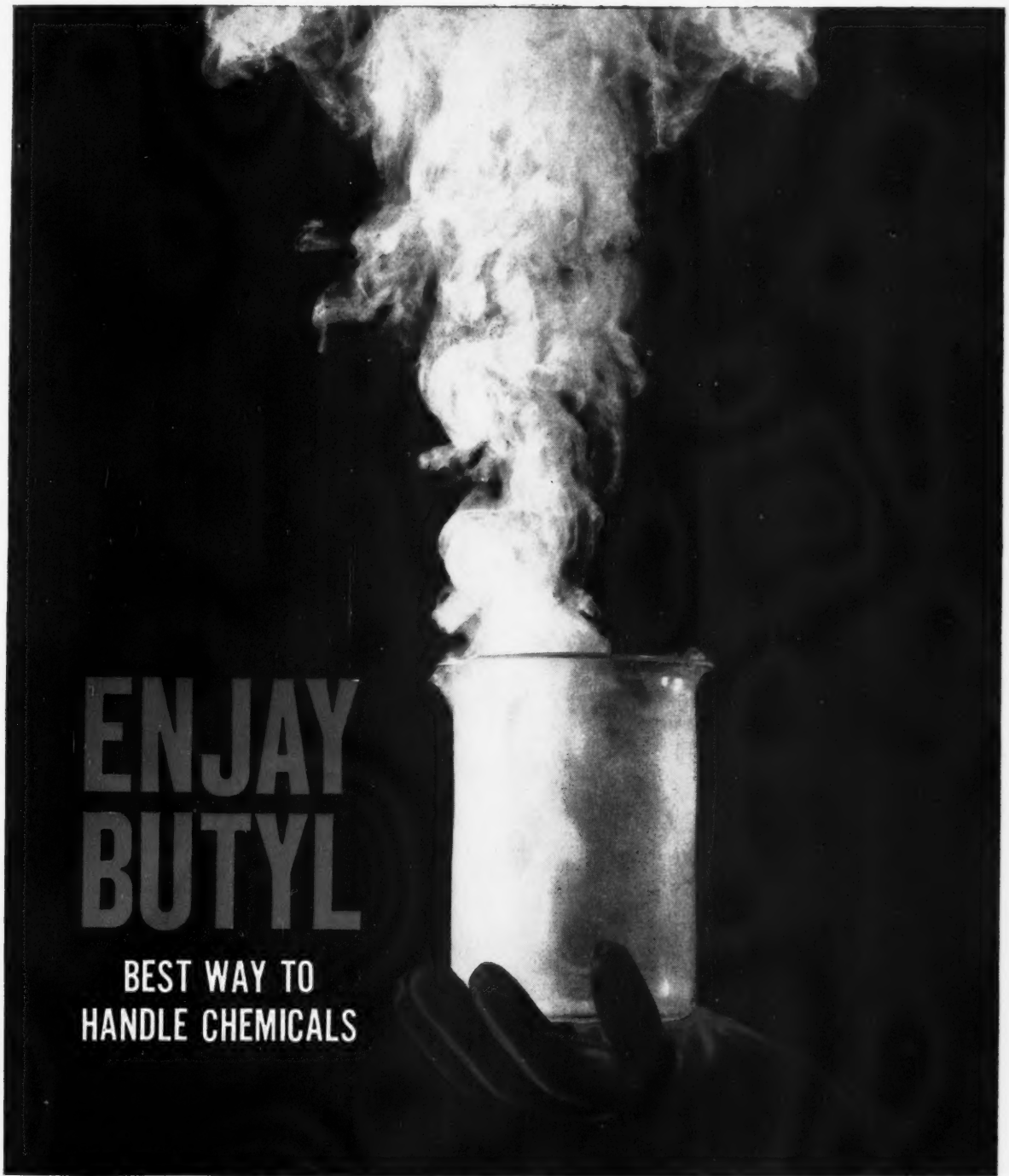
Production of butyl rubber was begun at the end of 1956, and recently experimental production of butyl

COMMERCIAL RUSSIAN SYNTHETIC RUBBERS

Code No.	Composition	Remarks
	Butadiene Rubbers	
SKB-35	Polybutadiene-sodium catalyzed	
SKB-50	Polybutadiene-sodium catalyzed	
SKBM	Polybutadiene-lithium catalyzed	For low-temperature use
SKV	Polybutadiene-potassium catalyzed	
	Butadiene-Styrene Rubbers	
SKS-10	10% Styrene	For low-temperature use
SKS-30	30% Styrene	SBR 1000 type
SKS-30 A	30% Styrene	Cold polymerized
SKS-30AM	30% Styrene	Cold polymerized, oil-extended
SKS-30M-15	30% Styrene	Oil-extended
SKS-90	90% Styrene	For soling
	Butadiene-Styrene Rubber Latices	
SKS-30 P	30% Styrene	
SKS-30 U	30% Styrene	
SKS-30 K	30% Styrene	
SKS-30 S	30% Styrene	
SKS-30 SR	30% Styrene	
SKS-50	50% Styrene	
SKS-50 I	50% Styrene	For wire and cable
SKS-50 GP	50% Styrene	For adhesives
	Butadiene-Methyl Styrene Rubbers	
SKMS-10	10% Methyl styrene	For low-temperature use
SKMS-30	30% Methyl styrene	Similar to SBR 1000
SKMS-30A	30% Methyl styrene	Cold polymerized
SKMS-30AM	30% Methyl styrene	Cold polymerized, oil-extended
SKMS-50	50% Methyl styrene	For soling, etc.
	Butadiene-Acrylonitrile Rubbers	
SKN-18	18% Acrylonitrile	
SKN-26	26% Acrylonitrile	
SKN-40	40% Acrylonitrile	
	Butadiene-Vinyl Pyridine Rubbers	
SKVMP-10	10% Vinyl pyridine	Very high abrasion resistance, low hysteresis, hot polymerized (50° C.)
SKVMP-15	15% Vinyl pyridine	
SKVMP-25	25% Vinyl pyridine	
SKVMP-40	40% Vinyl pyridine	
SKVMP-10A	10% Vinyl pyridine	Very high abrasion resistance, low hysteresis, cold polymerized (5° C.)
SKVMP-15A	15% Vinyl pyridine	
SKVMP-25A	25% Vinyl pyridine	
SKVMP-40A	40% Vinyl pyridine	
	Piperylene Rubber	
SKP	Poly,3-pentadiene	
	Butadiene-Piperylene Latices	
DP-25		
DP-50		
DP-60		Special for asbestos industry
	Chloroprene Rubbers	
Najrit		
Najrit A		For extra-strong adhesives
	Chloroprene Rubber Latices	
L-2		
L-3		
L-4		
L-7		
	Chloroprene-Styrene Rubbers	
Najrit S	3-5% Styrene	Inhibited crystallization

(*Continued on page 302*)

[1] "Rubber Trends—I," Mar., 1959. The Economist Intelligence Unit, Ltd., London, England, or Warren S. Lockwood, Inc., New York, N. Y.
[2] *Gummi-Asbest*, Mar., 1959, p. 146.
[3] *J. Polymer Sci.*, 31/122, 187 (1958).



Here are a few of the many chemicals that Butyl offers excellent resistance to:	
Dimethyl hydrazine	Cl Br methane
Phosphoric acid	Ozone
Sulfuric Acid	Hydrofluoric acid
Red fuming nitric acid	Ammonia
Oxygenated solvents	Molten sulfur

Enjay Butyl rubber, due to its unique and extremely low degree of unsaturation, offers excellent resistance to corrosive chemicals. Versatile Butyl is the preferred rubber for countless types of hoses, tank linings, gaskets, seals—and many other applications where exacting chemical resistance is required.

Butyl *also* offers . . . outstanding resistance to weathering, sunlight, heat, and electricity . . . abrasion tear and flexing . . . superior damping properties . . . and unmatched impermeability to gases and moisture.

Find out how this versatile rubber can improve your product. Call or write the Enjay Company, today!

ENJAY® BUTYL

EXCITING NEW PRODUCTS THROUGH PETRO-CHEMISTRY

ENJAY COMPANY, INC., *15 West 51st Street, New York 19, N. Y.*

Akron • Boston • Charlotte • Chicago • Detroit • Los Angeles • New Orleans • Tulsa

COMMERCIAL RUSSIAN SYNTHETIC RUBBERS
(Continued from page 300)

Code No.	Composition	Remarks
	Butadiene-Vinylidene Chloride Latex	
DVCHB-70		
	Butyl Rubber	
Butyl Kautschuk B		
	Dimethyl Siloxane Rubber	
SKT	Silicone rubber	
	Isoprene Rubber	
SKI	*Cis*-1,4, Polyisoprene	
	Polyisobutylene	

bromide rubbers was started; these products are compatible with other rubbers, and eventually large-scale output for use in tubeless tires is foreseen.

The polypiperylene (pentadiene) rubber SKP is soluble in benzene and chloroform; its second-order transition temperature is between —50 and —55° C. It is easily blended with other rubbers, but is readily attacked by atmospheric oxygen, especially at high temperatures, thus requiring antioxidants; and vulcanization is very slow, so that especially active accelerators are needed. Nevertheless, economic considerations make it interesting; large amounts of monomer are available from cracking gases and furfural, and so intensive research is in progress to improve its qualities.

The SKMVP-A, cold-polymerized (5° C.) series of butadiene/2-methyl-5-vinylpyridine rubbers are prepared with redox catalysts. They are considered superior to the butadiene/styrene copolymers—heat build-up under repeated deformation is especially low. Properties of the hot polymerized types (50° C.) are somewhat less favorable. Present research on these rubbers aims at a type with high cold resistance and absolute resistance to solvents, which will retain elasticity at temperatures from —55 to 200° C.

Development Rubbers

Among new rubbers produced experimentally are a copolymer of chloroprene and isoprene with inhibited crystallization and high resistance to cold; also a copolymer of chloroprene and acrylonitrile, with higher resistance to oils than the usual chloroprenes. Investigations are now also being conducted on polyfluoroprene, said to have unusual resistance to cold and the same oil-resistance as polychloroprenes. The fluororubbers are prepared by the catalytic method from vinylacetylene and hydrogen fluoride, with oxide of mercury suspended in vaseline oil as the catalyst.

On the research program, too, are acrylonitrile rubbers with thermal stability in air and oil at 200° C., further development of polyurethane rubbers, and the most intensive efforts to find a cheap method of making isoprene monomer for 1,4-*cis*-polyisoprene rubber (SKI).

Outlook

It is significant that the target for 1965 requires output of SKI to represent 25% of total Russian synthetic rubber; the proportion of chloroprene rubbers is to be increased from 7.6% (in 1958) to 12.6%. In general, the new rubbers are to be strongly pushed. By 1965, output of styrene rubbers is to be 2.4 times the 1958 figure: SKMS, three times; butyl rubber, 40 times; SKN, 14 times; and polyisobutylene, 10 times as high.

Most of the synthetic rubber, according to the author, goes into tires, 66% of which consisted of truck tires in 1958; tractor tires accounted for 12%; passenger-car tires for 9%; motorcycle tires, 9%, and others, 4%. Percentage-wise, the main changes for 1965 are to be a reduction to 7% in passenger-car tires, and an increase to 12% in motorcycle tires.

From another source it is learned that output of automotive tires in 1958 amounted to 14,400,000 units, against 12,800,000 units in 1957.

"Cottage Industry" For Rubber in Malaya?

Rubber planting will become a "cottage industry" under cooperative ownership of village communities within 15 years or so, P. J. A. Williams, a planter with wide experience, predicted on the eve of his retirement from Malaya. According to a *Straits Times* interview, Mr. Williams, who has managed Malayan rubber estates since 1911, feels that though prospects for the natural rubber industry in the next five or six years are very good, before long, big companies will find the cost of imported labor too high to compete with synthetic rubber; and he cites the many estates already being sold and cut up. He believes that eventually the only economical way of growing rubber will be as a cottage industry, and that fragmentation of estates is inevitable; nor, in his opinion, will this be a bad thing for the country "despite what big owners and labor leaders may say."

In rubber circles the reaction to these statements for the most part seems to be that Mr. Williams is one-sided and has failed to consider many aspects of the matter—that fragmentation is declining; that with government offers of more land, the attraction of cut-up estates is waning; that in any case, the government will not permit fragmentation to reach the acute stage Mr. Williams foresees; that fragmented estates are neither cheap nor are they economically sound propositions, and that people would prefer new planting and replanting to working old, cut-up estates. As to costs, producers are doing their utmost to reduce them, and replanting with high-yielding material is contributing toward achievement of this aim. Mr. Williams is also reminded that too much fragmentation would result in lowering quality, loss of revenue for the government, and unemployment for thousands of Indian laborers.

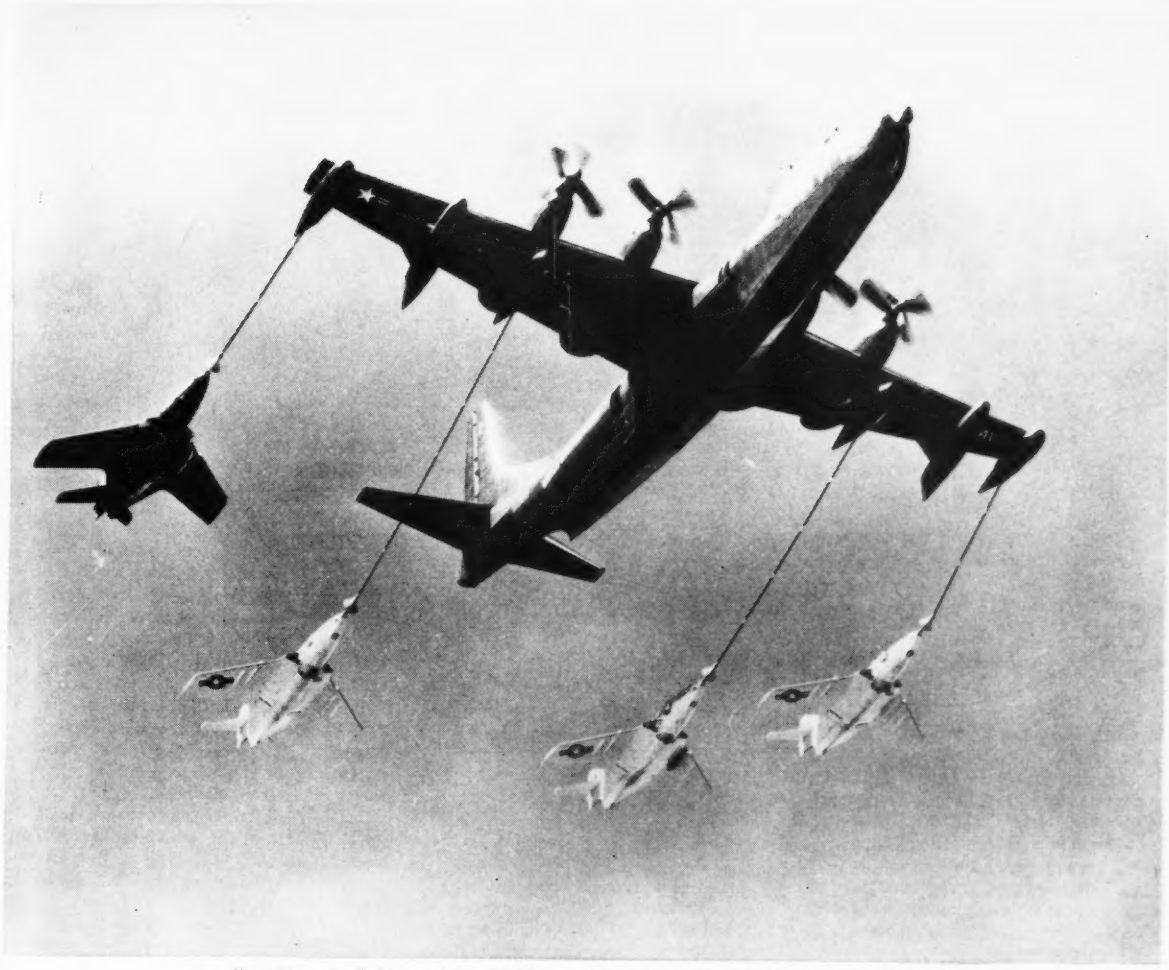
Aid for Smallholder

The problem of aiding the smallholder to improve his rubber and, incidentally, his own economic position is being attacked by the authorities from various angles, apparently with some degree of success.

The results of the publicity campaign initiated by the Rubber Industry Replanting Board last year are becoming apparent. Not only has there been a substantial increase in applications for aid to replant and new plant this year, but an important object of the campaign—to interest Malay rubber growers, who form the majority of smallholders—has been achieved to a satisfactory degree. Applications for grants to replant 53,346 acres out of the record 136,341 acres approved came from Malay smallholders. Chinese smallholders in Johore and Malacca accounted for the greater part of the remainder. The Federation Government will have to pay out more than $80,000,000 (Straits) in grants, spread over six years.

At the same time the Smallholders' Advisory Service of the Rubber Research Institute is attempting to teach smallholders how to improve the quality of their sheet. Of the 3,500,000 acres estimated to be the total area under rubber in Malaya, about 1,500,000 acres are distributed among some

(Continued on page 320)



Four Navy jet fighters take on fuel from a Convair R3Y-2 "Tradewind" in the first multiple refueling operation ever conducted from a seaplane. (UP Photo)

Making the refueling hose was a tricky problem, too!

"Dependable Taylor controls played an important part in processing in-flight refueling hose", says Hewitt-Robins, Stamford, Conn.

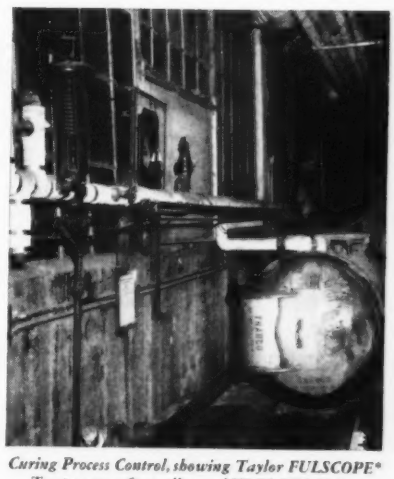
High speed, high altitude refueling of jet planes posed a tricky hose design problem. The hose required has to be resistant to jet-fuels; it has to withstand bending at extremely low temperatures; it has to absorb tremendous crush loads, yet coil easily on a small reel; it must not pull apart, even with buffeting end pulls in excess of 5,000 lbs.

Hewitt-Robins chemists and engineers licked all the problems and came up with a hose that met all the Air Force specifications.

Taylor instruments play an important role in the vulcanization of this hose by maintaining exact and constant curing temperatures. This insures optimum qualities in the cured rubber compounds.

When accuracy and dependability really count, remember that you can rely on Taylor controls . . . and on your experienced Taylor Field Engineer. Taylor Instrument Companies, Rochester, New York, or Toronto, Ontario.

*Trade-Mark



Curing Process Control, showing Taylor FULSCOPE Temperature Controller and HI-FLOW* Valve.*

Taylor Instruments MEAN ACCURACY FIRST

MARKET REVIEWS

Natural Rubber

The price of natural rubber during the March 16-April 15 period reached the highest point it has been for almost two years. The sentiment in both the New York and London markets has been extremely bullish. The present market, however, is not quite normal insofar as the speculative interest is so small that the shortage of supplies which has been developing is likely to be much more of a market factor than any profit taking on the part of speculators. There have been reports of fairly large Chinese short accounts in Singapore which would indicate, at least temporarily, a strong market with advancing prices. An extension of the current strike situation here, however, could have a retarding effect on this development.

Demand from Iron Curtain countries in the past year has increased tremendously. Russia and her satellites purchased 420,000 long tons of natural rubber in 1958, compared to 281,000 tons in the preceding year, according to one source.

The United States factory demand for natural rubber was said to be focused on nearby deliveries.

March sales, on the New York Commodity Exchange, totaled 13,310 tons, compared with 6,210 tons for February contract. There were 21 trading days in March, and 22 during the March 16-April 15 period.

On the physical market, RSS #1, according to the Rubber Trade Association of New York, averaged 31.06¢ per pound for the March 16-April 15 period. Average March sellers' prices for representative grades were: RSS #3, 31.23¢; #3 Amber Blankets, 30.07¢; and Flat Bark, 27.04¢.

REX CONTRACT

1959	Mar. 20	Mar. 26	Apr. 3	Apr. 10
Mar.	31.65	33.15	...	...
May	31.85	32.50	32.55	34.00
July	31.85	32.35	32.35	33.60
Sept.	31.85	32.35	32.30	33.10
Nov.	31.80	32.25	32.25	33.10
1960				
Jan.	31.80	32.15	32.20	33.05
Mar.	31.75	32.10	32.15	33.05
May	...	...	32.10	33.00

NEW YORK OUTSIDE MARKET

	Mar. 20	Mar. 26	Apr. 3	Apr. 10
RSS #1	31.88	32.25	32.50	33.38
2	31.75	32.13	32.25	32.75
3	31.63	32.00	32.00	32.38
Pale Crepe #1 Thick	33.25	33.63	34.00	34.25
Thin	33.25	33.63	33.75	34.00
#3 Amber Blankets	30.50	30.88	31.25	31.63
Thin Brown Crepe	30.38	30.75	31.00	31.38
Standard Flat Bark	27.63	28.00	28.00	27.25

Synthetic Rubber

More new records were established in March in that total new rubber consumption reached 146,815 long tons for a new monthly high; while production of all types of synthetic rubber reached 111,256 long tons for another monthly high, according to the regular report of The Rubber Manufacturers Association, Inc.

Undoubtedly these consumption and production figures were related to the strike threats in the steel and rubber goods manufacturing industries; the latter was realized in April with strikes at the plants of U. S. Rubber, Firestone, and Goodrich. Synthetic rubber producing plants (SBR) of these rubber companies were not affected except in one or two minor instances, but if the strikes in the consuming plants were not settled by May 1, synthetic rubber producing plants were planning to reduce operations to maintain proper balance between supply and demand.

Synthetic rubber consumption in March amounted to 94,655 tons, as compared with the February figures of 87,393 tons. Consumption by types, in long tons, March *versus* February was as follows: SBR, 78,800, against 72,558; neoprene, 7,250, against 6,885; butyl, 5,750 against 5,256; nitrile, 2,855, against 2,694.

Exports of synthetic rubber rose in March to 18,265 tons, contrasted with the 15,836 tons sent abroad in February; the increases were about in proportion to the total increase except for butyl rubber, where March exports of 2,700 tons were almost 2½ times the 1,169 tons exported in February. The strike in Canada of union employes at the Polymer Corp.'s synthetic rubber plant, which began in mid-March, probably accounts for much of this increased export tonnage.

The record synthetic rubber production figure of 111,256 tons in March was probably due mostly to the 91,800 tons of SBR made in this month. Carbon black masterbatches, which are now enjoying renewed demand because of the new dispersant-free types, amounted to 15% of the total SBR produced (calculated on the net rubber in these masterbatches as related to total SBR on a net rubber basis). Producers are concerned, however, about the low prices of carbon black masterbatches in view of rising production costs resulting from the very considerable recent capital investment made in new equipment with which to produce these masterbatches. RUBBER WORLD's recent survey of all available commercial types of SBR's (to be published in June) shows that there are 68 different carbon black masterbatches on the market from the several producers. Many of these black masterbatches differ only slightly from one another, and producers might reduce the overall costs of production for these masterbatches by eliminating some of these grades.

Production and consumption of synthetic rubber during the second quarter will depend on the duration of the strikes at three of the Big Four company plants. Even if the strikes are settled before May 1, second-quarter figures are expected to be at least 10% less than for the first quarter because, as John W. McGovern, president of U. S. Rubber, said on April 21, some of this first-quarter business was borrowed from the second quarter in anticipation of the rubber industry strike threat.

Latex

During the period under review (March 16-April 15) interest in drum latex was fairly widespread, and a moderate amount of business was reported. The offtake for nearby shipment appears at present to be running more or less in line with current production, according to one source. As a result, the recent advance in the differential has been consolidated.

Some business in bulk latex has taken place, and this section of the market is quite steady. With producers reported to be well sold for nearby shipment, the accent has been on slightly more distant positions.

Consumption here for February is given at 6,489 tons, against 7,184 tons

CYANAMID RUBBER
Chem Lines

NO. 22 OF A SERIES Published by AMERICAN CYANAMID COMPANY, Rubber Chemicals Department, Bound Brook, New Jersey

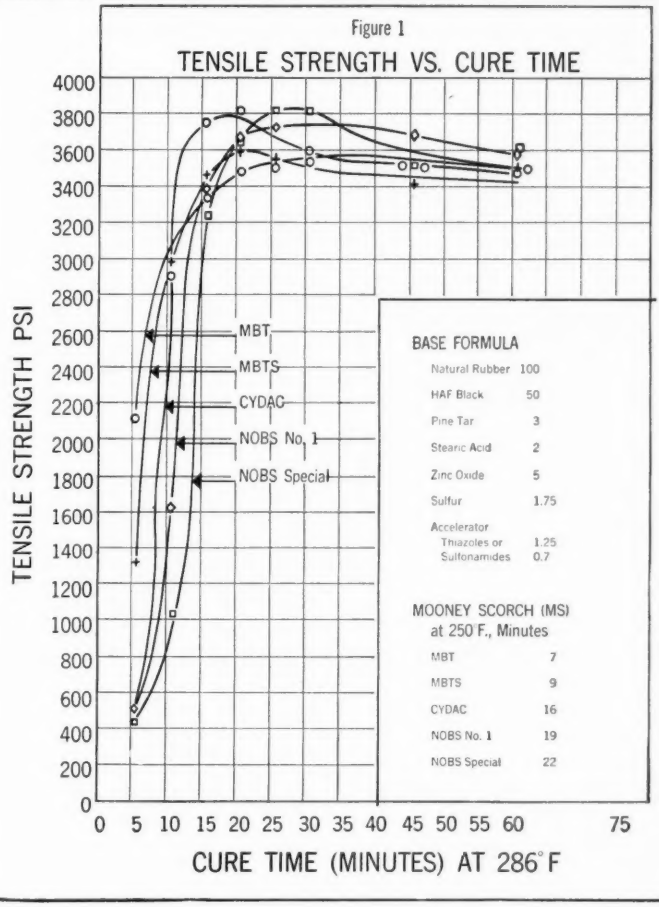
Equivalent Cure Rates for Natural Rubber

Previous articles (*Rubber Chem Lines 20* and *21*) have illustrated the use of Cyanamid's complete range of accelerators to provide varying degrees of processing safety, while maintaining the same cure rate, with SBR. The same benefits are available for natural rubber. In this experiment a typical natural rubber tread stock was mixed with each of Cyanamid's delayed-action accelerators.

The graph illustrates tensile strengths for a series of cure times at 286°F. It is seen that the curing rates for the accelerators are essentially equal. This is indicated graphically by the parallel slopes of the initial rise, and the similar time intervals from the start of vulcanization to the beginning of the leveling-off or plateau at full cure. The variation in processing safety is shown by the scorch times.

Where even greater delayed action is needed, DIBS® accelerator is also used successfully in natural rubber. The full advantage of its great processing safety is ordinarily used where much higher curing temperatures are involved. At the temperature of the present experiment, it would be used with an activator such as DPG.

Figure 1



Translucent Soling Stock

Modern fashion has created an increasing demand for extremely light-colored translucent soling. Modern technology has provided a combination of elastomer, reinforcing pigment, curing system and antioxidant which satisfies this demand as never before. The following formula should provide a good starting point in the development of such a stock:

	Parts
ASRC 3106 or Krylene NS	100
Hi-Sil 233	40
Maglite D	5
Staybelite Resin	5
Diethylene Glycol	1
Antioxidant 2246®	0.5
Marbon 8000	15
Di-Cup 40-C	3.75 as is

Cure 7½ to 15 minutes at 300°F.

The light color of this stock is due to the original light color of the polymer and is maintained by the Di-Cup curing system. The Hi-Sil 233 is a reinforcing white pigment; the diethylene glycol is necessary to "condition" the pigment. The curing system used here results in a stock with excellent aging properties. Antioxidant 2246 enhances this characteristic and also serves as a retarder, while maintaining the light color. The scorchiness of the Di-Cup curing system has been one of the problems with its use. The fact that Antioxidant 2246 is an effective retarder should be of interest. The retarding effect is illustrated by the scorch times:

Mooney Scorch (MS) at 250°F:

No Antioxidant . . . . . 17 minutes
0.5 parts Antioxidant 2246 . . 34 minutes

Trademarks and/or sources:

ASRC 3106	American Synthetic Rubber Corp.
Krylene NS	Polymer Corp. Ltd.
Hi-Sil 233	Columbia Southern Chemical Corp.
Maglite D	Marine Magnesium Div., Merck & Co.
Staybelite Resin	Hercules Powder Co.
Marbon 8000	Marbon Chem. Div., Borg-Warner Corp.
Di-Cup 40-C	Hercules Powder Co.

in January. Stocks at the end of February stood at 10,842 tons, compared with 10,025 tons on January 31.

Prices for ASTM centrifuged concentrated natural latex, in tank-car quantities, f.o.b., rail tank car, ran about 41.92¢ per pound solids. Synthetic latices prices were 21.5 to 38.2¢ for SBR; 37 to 53¢ for neoprene; and 46 to 60¢ per pound for the nitrile types.

Final January and preliminary February domestic figures for all latices were reported by the United States Department of Commerce as follows:

(All Figures in Long Tons, Dry Weight)

Type of Latex	Production	Imports	Consumption	Month-End Stocks
Natural				
Jan.	0	*	7,184	10,025
Feb.	0	*	6,489	10,482
SBR				
Jan.	7,801	—	6,886	7,822
Feb.	7,753	—	7,083	10,482
Neoprene				
Jan.	1,049	0	925	1,551
Feb.	998	0	859	2,710
Nitrile				
Jan.	1,104	0	1,244	2,418
Feb.	1,161	0	1,009	2,535

* Not available yet for period covered.

Reclaimed Rubber

Reclaimed rubber sales continued on a high level for the first three months of 1959. The April strike situation in the rubber industry, however, was expected to have an effect on the amount of reclaim consumption which would be proportional to the length of the time of the strike. One source indicated that it has sold a substantial amount of reclaim to one of the big four rubber companies which was out on strike; further sales to this company were expected to be curtailed until the strike had been settled.

Despite the strike situation, automobile production during the period under review (March 16-April 15) was up; consequently original-equipment tire sales remained on an equivalent plane. This factor together with the report that replacement sales continued at a fairly high level explained why the overall reclaim picture was not adversely affected by the strike situation in late April. There were also reports that automobile mat and battery box production continued on a significant level; even though hose and belting production was somewhat spotty during April.

According to The Rubber Manufacturers Association, Inc., report, March production of reclaimed rubber was 28,950 long tons; while consumption was 27,600 long tons.

RECLAIMED RUBBER PRICES

Whole tire, first line	$0.11
Third line	.1025
Inner tube, black	$0.16
Red	.21
Butyl	.14
Light carcass	.22
Mechanical, light-colored, medium gravity	.155
Black, medium gravity	.085

The above list includes those items or classes only that determine the price basis of all derivative reclaim grades. Every manufacturer produces a variety of special reclaims in each general group separately featuring characteristic properties of quality, workability, and gravity, at special prices.

Scrap Rubber

Quiet trading conditions prevailed in the scrap rubber market during the period under review (March 16-April 15). Consumers, for some weeks now, have been restricting their purchases, apparently reflecting a letdown in their sales of reclaimed rubber products to the automotive industry. Prices showed no change from the previous period.

During this period the Scrap Rubber & Plastics Institute met as part of the forty-sixth annual National Association of Waste Material Dealers' convention at Chicago, April 5-8. Benjamin W. Wendrow, technical manager of U. S. Rubber Reclaiming Co., Buffalo, N. Y., was the principal guest speaker. He spoke on "Reclaimed Rubber—Its Place in the Rubber Industry."[1]

	Eastern Points	Akron, O.
	Per Net Ton	
Mixed auto tires	$11.00	$12.00
S. A. G. truck tires	nom.	15.50
Peeling, No. 1	nom.	23.00
2	nom.	20.00
3	nom.	15.50
Tire buffings	nom.	nom.
	(¢ per Lb.)	
Auto tubes, mixed	3.25	3.25
Black	5.75	5.75
Red	6.25	6.25
Butyl	4.75	4.75

[1] See this issue, p. 275.

Rayon and Nylon

American Viscose Corp., New York, N. Y., is counting on rising automobile sales to aid its operations in the current year, according to a leading spokesman for the textile firm. For the first quarter of this year, the company's sales are expected to be on a par with those of the final quarter of 1958, but earnings are likely to be a good deal higher, he predicted.

Tyrex viscose tire cord and other yarns sold for automotive use now account for 20% of the firm's overall business, it was reported.

Rubber companies and the automobile companies are promoting tires with Tyrex cord in their advertising and on their television programs, and Tyrex viscose cord is now receiving sufficient market support to keep it in the position of a preferred product, it was said. For Tyrex and other viscose tire yarns American Viscose has an annual capacity of 82 million pounds.

Total packaged production of rayon and acetate filament yarn during March was 62,900,000 pounds, consisting of 28,400,000 pounds of high-tenacity rayon yarn and 34,500,000 pounds of regular-tenacity rayon yarn. Production for February had been: total, 54,700,000 pounds, including regular-tenacity rayon yarn, 29,500,000 pounds; and high-tenacity rayon yarn, 25,200,000 pounds.

Filament yarn shipments to domestic consumers for March totaled 65,200,000 pounds, of which 28,900,000 pounds were high-tenacity rayon yarn, and 36,300,000 pounds were regular-tenacity rayon yarn. Shipments for February had been: total, 56,300,000 pounds; high-tenacity, 26,100,000 pounds; regular-tenacity, 30,200,000 pounds.

There were no additional reported price changes during the period under review.

RAYON PRICES

Tire Fabrics	
1100/490/2	$0.625/$0.78
1650/908/2	.685/ .685
2200/980/2	.625/ .655
Tire Yarns	
High-Tenacity	
1100/ 490, 980	.66/ .66
1100/ 490	.66/ .66
1150/ 490, 980	.59/ .63
1165/ 480	.59/ .65
1230/ 490	.59/ .63
1650/ 720	.55/ .58
1650/ 980	.55/ .58
1875/ 980	.55/ .58
2200/ 960	.54/ .57
2200/ 980	.54/ .57
2200/1466	.64
4400/2934	.60
Super-High Tenacity	
1650/ 720	.60
1900/ 720	.58

NYLON PRICES

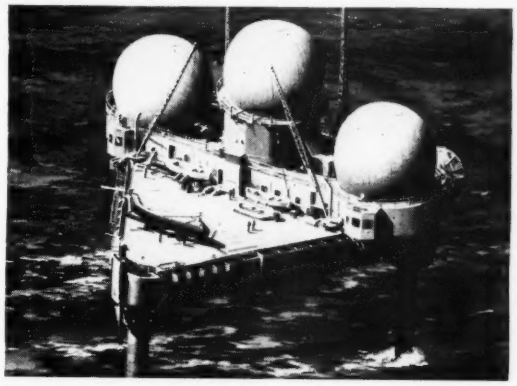
Tire Yarns	
840/ 140	1.10/ 1.20
1680/ 280	1.20

Industrial Fabrics

Though the industrial grey cotton cloth market is in the opening stages of its slack replacement contract interval, it is busier than usual on fill-in quantity business. Numerous small-size orders were processed during the last week of the period under review (March 16-April 15). More quick goods than could be found became involved in inquiries that made the rounds in first and resale channels. Indicated was the fact that more finished fabrics are required than were balanced by converters' and end-users' spot and nearby grey goods.

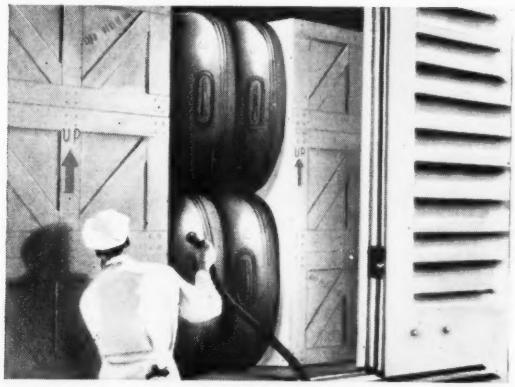
(*Continued on page 320*)

AIR-SUPPORTABLES



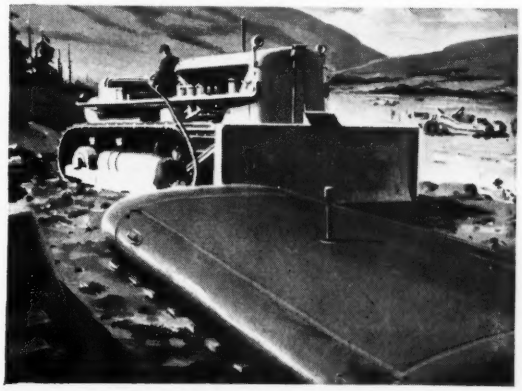
"Texas Tower" radomes of rubberized nylon are supported by interior air pressure. Nylon base fabric by Wellington Sears.

INFLATABLES



Inflatable dunnage bags are made of neoprene-coated nylon enclosing rubber air chamber. Wellington Sears base fabric.

COLLAPSIBLES



Collapsible fuel tank, made of rubberized nylon fabric, is a filling station dropped from the air. Base fabric by Wellington Sears.

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Synthetic Rubbers and Latices*

Monomers

11-80, 100, 200, 112-3 Triols	lb.	$0.255	
11-300	lb.	.265	
11-400	lb.	.325	
Acrylonitrile	lb.	.27	
Butadiene	lb.	.15	
Dow Styrene	lb.	.12	
H99, N99	lb.	.205	
RG	lb.	.17	
Vinyltoluene	lb.	.17	
EGD	lb.	1.75	/ $2.00
Hylene M	lb.	1.26	/ 1.28
M-50	lb.	.87	/ .89
T	lb.	1.02	/ 1.04
TM	lb.	.87	/ .89
-65	lb.	.92	/ .94
Isobutylene	gal.	.38	
Isoprene	lb.	.25	
Mondur-C	lb.	1.05	
Monomer MG-1	lb.	1.00	/ 1.25
-S	lb.	.85	
MPL	lb.	1.75	/ 2.00
Multron R-2	lb.	.54	
P200	lb.	.23	
Rohm & Haas ethyl acrylate	lb.	.34	/ .36
Glacial methacrylic acid	lb.	.45	/ .47
Methyl acrylate	lb.	.37	/ .39
Methacrylate	lb.	.29	/ .31

Shortstops

DDM	lb.	.88	/ .915
Mercaptan 174	lb.	.38	/ .50
Sharstop	lb.	.33	/ .37
268	lb.	.52	/ .53
Tecquinol	lb.	.825	/ .845
Thiostop K	lb.	.50	/ .53
N	lb.	.38	/ .47
Vulnapol KM	lb.	.52	/ .56
NM	lb.	.38	/ .42
Wingstop B	lb.	.38	

Acrylic Types

Acrylon BA-15	lb.	1.25[a]	
EA-5	lb.	1.00[a]	
Hycar 4021		1.34[c]	/ 1.35[c]

Latices

Hycar 2600X30, 2600X39, 2601	lb.	.50	/ .56

Fluorocarbon Types

Kel-F Elastomer	lb.	15.00	/ 16.00
5500, 820 (Latex)	lb.	15.00	/ 17.15
Viton A, AHV	lb.	15.00	

Isobutylene Types

Enjay Butyl 035, 065, 150			
215, 217, 218			.23[a]
165, 268, 325, 365			.24[a]
Hycar 2202		.65[c]	/ .75[c]
Polysar Butyl 100, 200, 300 400			.245[c]
101			.2775[a]
301			.255[c]
Vistanex LM			.45[a]
MM			.35[a]

Neoprene Types (CR)

Neoprene Type AC, AD, CG		.55[a]	/ .575[a]
FB		.65[a]	/ .67[a]
GN, GN-A, WX		.41[a]	/ .435[a]
GRT, S		.42[a]	/ .445[a]
KNR		.75[a]	/ .775[a]
W, WHV		.39[a]	/ .415[a]
WRT		.45[a]	/ .475[a]

Latices

Neoprene Latex 571, 842-A		.37[a]	/ .47[a]
572		.39[a]	/ .40[a]
60, 601-A		.40[a]	/ .50[a]
635		.41[a]	/ .51[a]
650		.42[a]	/ .52[a]
735, 736		.38[a]	/ .48[a]
750		.39[a]	/ .49[a]
950		.47[a]	/ .57[a]

Nitrile Types

Butaprene NF			.49[b]
NH			.65[b]
NL			.50[b]
NXM			.58[b]
Chemigum, N1NS			.64[b]
N3NS, N5			.58[b]
N6, N-6B, N7, N8			.50[b]
N600			.50[b]
Hycar 1001, 1041		.58[c]	/ .59[a]
1002, 1042, 1043, 1052, 1053, 1312		.50[c]	/ .51[c]
1014		.60[c]	/ .61[c]
1072		.64[c]	/ .65[c]
1411		.62[c]	/ .63[c]
1432, 1441		.59[c]	/ .60[c]
Paracril, AJ			.485[c]
B, BJ, BJLT, BLT			.51[c]
C, CLT			.59[c]
CV			.60[c]
D			.65[c]
18-80			.60[c]
Polysar Krynac 800, 802, 803			.50[c]
801			.58[c]

Latices

Butaprene N-300			$0.46[b]
N-400, N-401			.54[b]
Chemigum 200			.49[b]
235 CHS, 236			.54[b]
245 B, 245 CHS, 246, 247, 248			.46[b]
Hycar 1512, 1552, 1562, 1577		$0.46[c]	/ .52[c]
1551, 1561, 1571		.54[c]	/ .60[c]
1852		.46[c]	/ .52[c]
Nitrex 2612, 2614		.46[a]	/ .52[a]
2615		.51[a]	/ .57[a]
2616		.54[a]	/ .60[a]
2617		.46[a]	/ .52[a]
2619		.53[a]	/ .59[a]
2620, 2625		.46[a]	/ .52[a]

Polyethylene Type

Hypalon 20, 30	lb.	.70	/ .725

Polysulfide Types

Thiokol LP-2, -3, -31, -32, -33			.96[a]
-8			1.35[a]
-205			4.00[a]
Type-A			.50[a]
FA			.69[a]
ST			1.25[a]

Latices

Thiokol Latex (dry wt.)			
Type MX			.80[a]
WD-2			1.25[a]
-6		.80[a]	/ 1.25[a]

Silicone Types

GE (compounded)		2.29[c]	/ 4.90[c]
Silicone gum (not compounded)		3.85[c]	/ 4.55[c]
Silastic (compounded)		2.95[b]	/ 3.50[b]
(Partly compounded)		3.15[b]	/ 3.60[b]
(Uncompounded)		4.05[b]	/ 4.35[b]
LS-53		18.00[b]	/ 4.35[b]
Union Carbide (compounds)		2.35[b]	/ 3.20[b]
(Gums)		3.85[b]	/ 4.25[b]

Styrene Types

Hot SBR†

Ameripol 1000, 1001, 1006, 1007		.24[c]	/ .247[c]
1002		.2435[c]	/ .2495[c]
1006 Crumb		.2475[c]	/ .2535[c]
1009		.2475[c]	/ .2535[c]
Crumb		.259[c]	/ .265[c]
1011		.2475[c]	/ .2535[c]
1012		.2425[c]	/ .2485[c]
Crumb		.249[c]	/ .255[c]
1013		.25[c]	/ .2560[c]
Crumb		.2615[c]	/ .2675[c]
ASRC 1004, 1006		.241[c]	/ .2475[c]
1009		.2475[c]	/ .2535[c]
1018		.27[c]	/ .276[c]
1019		.265[c]	/ .271[c]
3105		.241[c]	/ .247[c]
3110		.26[c]	/ .266[c]
Copo 1006		.241[c]	/ .247[c]
FR-S 1000, 1001, 1004, 1006		.241[c]	/ .247[c]
1007		.241[c]	/ .247[c]
1009		.2475[c]	/ .2535[c]
1010		.26[c]	/ .266[c]
1012		.2425[c]	/ .2485[c]
1013		.25[c]	/ .256[c]
Crumb		.2615[c]	/ .2675[c]
1014		.281[c]	/ .287[c]
141		.28[c]	/ .286[c]
181		.241[c]	/ .247[c]
Naugapol 1016, 1019		.265[b]	/ .27[b]
1018		.27[b]	/ .275[b]
1021		.30[b]	/ .305[b]
1022		.28[b]	/ .285[b]
1023		.285[b]	/ .29[b]
6003		.27[b]	/ .275[b]
Philprene 1000, 1001, 1006			.241[b]
1009			.2475[b]
1010			.26[b]
1018			.27[b]
1019			.265[b]
Plioflex 1006		.241[c]	/ .247[c]
Polysar S, 630		.241[c]	/ .247[a]
S-X-371		.255[c]	/ .261[c]
S-1000, -1006, -1013			.23[a]
-1002, -1011			.2325[a]
-1009			.24[a]
Synpol 1000, 1001, 1006, 1007, 1061		.241[b]	/ .247[b]
1002		.2435[b]	/ .2495[b]
1012		.2425[b]	/ .2485[b]
1009		.2475[b]	/ .2535[b]
8000		.241[b]	/ .247[b]
X-274		.255[c]	/ .261[c]

Hot SBR Black Masterbatch

Philprene 1100			.194
1104			.190[b]
S-1100			.185[a]

[a] Freight extra.
[b] Minimum freight allowed.
[c] Freight prepaid.
* Prices are per pound carload of tank-car dry weight unless other wise specified.
† SBR—Styrene-butadiene rubber.
‡ BR—Butadiene rubber.

Cold SBR

Ameripol 1500, 1501, 1502		$0.241[c]	/ $0.247[c]
ASRC 1500, 1502		.241[c]	/ .247[c]
1503		.2625[c]	/ .2685[c]
C-102			.23[a]
Copo 1500, 1502		.241[c]	/ .247[c]
1505		.261[c]	/ .267[c]
FR-S 1500, 1502, 146, 179		.241[c]	/ .247[c]
127		.26[c]	/ .266[c]
Naugapol 1503		.2625[b]	/ .2675[b]
1504		.295[b]	/ .30[b]
6100		.31[b]	/ .315[b]
Philprene 1500, 1502			.241[b]
1503			.2625[b]
Plioflex 1500, 1502			.241[c]
Polysar Kryflex 200			.251[c]
SS-250, SS-250-Flake			.2875[c]
Krylene, NS			.241[a]
S-1500, S-1502			.23[a]
S-1506			.25[a]
Synpol 1500, 1502, 1551		.241[b]	/ .247[b]

Cold SBR Black Masterbatch

Ameripol 4600		.241[c]	/ .247[c]
4650		.182[c]	/ .188[c]
4651		.177[c]	/ .183[c]
4652		.1425[c]	/ .1485[c]
4654		.187[c]	/ .193[c]
4655		.182[c]	/ .188[c]
Baytown 1600, 1601, 1602			.193[b]
CB-102			.185[a]
Philprene 1600, 1601			.193[b]
1605			.19[b]
S-1600, -1602			.1825[a]
-1605			.18[a]
Synpol 8150		.193[b]	/ .199[b]

Cold SBR Oil Masterbatch

Ameripol 1703		.206[c]	/ .212[c]
1705		.2035[c]	/ .2095[c]
1707, 1708		.191[c]	/ .197[c]
1710, 1712		.1885[c]	/ .1945[c]
4700		.175[c]	/ .181[c]
4701		.1725[c]	/ .1785[c]
ASCR 1703		.206[c]	/ .212[c]
1708		.191[c]	/ .197[c]
1712		.1885[c]	/ .1945[c]
1713		.175[c]	/ .181[c]
Carbomix 3750		.182[c]	/ .188[c]
3752		.1845[c]	/ .1905[c]
3754		.177[c]	/ .183[c]
Copo 1712		.1885[c]	/ .1945[c]
1773		.206[c]	/ .212[c]
1778		.191[c]	/ .197[c]
3900		.231[c]	/ .237[c]
FR-S 1703		.206[c]	/ .212[c]
1710		.1885[c]	/ .1945[c]
1712		.1885[c]	/ .1945[c]
123		.196[c]	/ .202[c]
154, 155		.1885[c]	/ .1945[c]
173		.206[c]	/ .212[c]
178		.191[c]	/ .197[c]
Philprene 1703			.206[b]
1706			.203[b]
1708			.191[b]
1710, 1712			.1885[b]
Plioflex 1703, 1773		.206[c]	/ .212[c]
1710, 1712		.1885[c]	/ .1945[c]
1713		.175[c]	/ .181[c]
1714C		.1725[c]	/ .1785[c]
1773		.206[c]	/ .212[c]
1778		.191[c]	/ .197[c]
Polysar Krynol 651			.1885[c]
652			.191[c]
S-1703			.195[a]
-1707			.18[a]
-1709, -1712			.1775[a]
-7701			.185[a]
Synpol 1703		.206[b]	/ .212[b]
1707, 1708		.191[b]	/ .197[b]
1711		.19[b]	/ .196[b]
1712		.1885[b]	/ .1945[b]
8200		.191[b]	/ .197[b]
8201		.175[b]	/ .181[b]

Hot SBR Latices

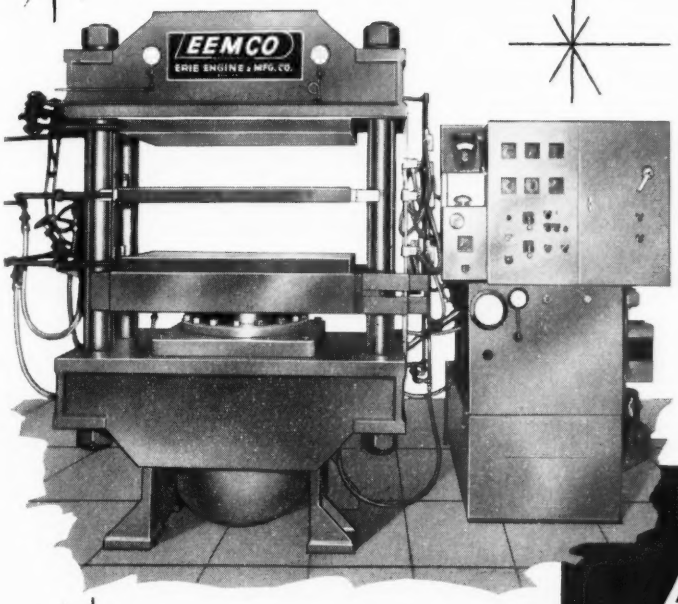
FR-S 2000, 2001		.2725[c]	/ .3425[c]
2002		.35[c]	/ .36[c]
2003, 2004		.305[c]	/ .36[c]
2006		.29[c]	/ .382[c]
Naugatex 2000, 2001		.2775[a]	/ .3575[a]
2002		.30[a]	/ .37[a]
2006		.29[a]	/ .42[a]
Pliolite Latex 2000, 2001			.2825[c]
2076			.295[c]
Polysar Latex II			.29[c]
IV			.2775
S-2000, 2006			.26[a]

Cold SBR Oil-Black Masterbatch

Ameripol 1805		.155[c]	/ .161[c]
4750		.1545[c]	/ .1605[c]
4751		.140[c]	/ .146[c]
4752		.160[c]	/ .166[c]
4753		.148[c]	/ .154[c]
Baytown 1801			.176[b]
Carbomix 3751, 3758		.1545[c]	/ .1605[c]
3753, 3759		.164[c]	/ .170[c]
3755		.147[c]	/ .153[c]
3756		.1576[c]	/ .1636[c]
3757		.148[c]	/ .154[c]

(Continued on page 320)

HYDRAULIC PRESSES for Rubber and Plastics



Illustrated Compression Molding Press with 314 ton capacity. Platen sizes 45″ x 30″—2-10″ openings, with semi-automatic controls. EEMCO builds a complete line of Presses for Laminating, Transfer Molding and Reinforced Plastics.

. . . designers and builders of a complete line of MILLS and PRESSES

EEMCO

ERIE ENGINE & MFG. CO.

951 East 12th St., ERIE, PA.

World leader for

TEST TUBE AGING

Scott Model LG

- No temperature gradient.
- Excellent stability of temperature: within ±1°.
- Designed with controls to 600°F; slight modifications permit temperatures to 750°F.

Specify the product of the world leaders in testing equipment, certified DEPENDABLE by the fact that—

32% of MODEL LG ORDERS ARE REPEATS!

Price $914.
F.O.B. PROVIDENCE
COMPLETE including
28 test tubes
28 stoppers
56 vent tubes
Control Box
Thermal Regulator

Test tubes are glass for ease of cleaning

SCOTT TESTERS, INC.
90 Blackstone St., Providence, R. I.
Representatives in Foreign Countries

New Symbol of World Standard Testing

Compounding Ingredients*

Abrasives

Pumicestone, powdered	lb.	$0.0363 /	$0.065
Rottenstone, domestic	lb.	.03 /	.04
Shelblast	ton	80.00 /	165.00
Walnut Shell Grits	ton	50.00 /	160.00

Accelerators

A-1 (Thiocarbanilide)	ton	.50 /	.57
A-32	ton	.66 /	.80
A-100	lb.	.52 /	.66
Accelerator 49		.59 /	.60
52	lb.	1.14	
57, 62, 67, 77	lb.	1.04	
66	lb.	4.25	
89	lb.	1.20	
108	lb.	.92 /	.97
552	lb.	2.25	
808	lb.	.66 /	.68
833	lb.	1.17 /	1.19
Altax	lb.	.54 /	.56
Arazate	lb.	2.25 /	2.30
Beutene	lb.	.66 /	.71
Bismate	lb.	3.00	
B-J-F	lb.	.27 /	.32
Butasan	lb.	1.04	
Butazate	lb.	1.04 /	1.09
Butyl Accelerator Eight	lb.	1.35	
Namate	lb.	.45 /	.50
Zimate	lb.	1.04	
Ziram	lb.	.89 /	1.04
Captax	lb.	.44 /	.46
Conac S	lb.	.76 /	.78
C-P-B	lb.	1.95 /	2.00
Cumate	lb.	1.45	
Cydac	lb.	.76 /	.78
Diba	lb.	.85	
Dipac	lb.	.85	
DOTG (diorthotolylguanidine)			
Cyanamid	lb.	.69 /	.70
Du Pont	lb.	.69 /	.70
DPG (diphenylguanidine)			
Cyanamid	lb.	.49 /	.50
Monsanto	lb.	.52 /	.58
El-Sixty	lb.	.62 /	.64
Ethasan	lb.	1.04	
Ethazate	lb.	1.04 /	1.09
50-D	lb.	.87 /	.92
Ethyl Seleram	lb.	3.00	
Thiurad	lb.	1.04	
Thiram	lb.	1.04	
Tuads	lb.	1.04	
Tuex	lb.	1.04 /	1.09
Zimate	lb.	1.04	
Ziram	lb.	.89 /	1.04
Ethylac #650	lb.	.93 /	.95
Guantal	lb.	.60 /	.67
Hepteen	lb.	.44 /	.50
Base	lb.	1.85 /	1.90
Ledate	lb.	1.04	
MBT (2-mercaptobenzothiazole)			
American Cyanamid	lb.	.44 /	.46
Du Pont	lb.	.44 /	.46
Naugatuck	lb.	.44 /	.49
-XXX, Cyanamid	lb.	.55 /	.57
MBTS (mercaptobenzothiazyl disulfide)			
Cyanamid	lb.	.54 /	.56
Du Pont	lb.	.54 /	.56
Naugatuck	lb.	.54 /	.59
-W Cyanamid	lb.	.59 /	.61
Merac #225	lb.	.75 /	1.05
Mertax	lb.	.55 /	.57
Methasan	lb.	1.04	
Methazate	lb.	1.04 /	1.09
Methyl Thiram	lb.	1.14	
Tuads	lb.	1.14	
Zimate	lb.	1.04	
Monex	lb.	1.14 /	1.19
Mono-Thiurad	lb.	1.14	
2-MT (2-mercaptothiazoline)			
Cynamid	lb.	88 /	.90
Du Pont	lb.	1.00	
NA-22	lb.	1.05	
NOBS No. 1	lb.	.76 /	.78
Special	lb.	.80 /	.82
O-X-A-F	lb.	.55 /	.60
Pennac SDB	lb.	.45 /	.48
Pentex	lb.	1.24 /	1.29
Flour	lb.	.30 /	.35
Permalux	lb.	2.25	
Phenex	lb.	.52 /	.59
Pip-Pip		2.07	
Polyac Pellets	lb.	1.85	
R-2 Crystals	lb.	4.35	
Rotax	lb.	.55 /	.57
RZ-50, -50B	lb.	1.00	
S. A. 52	lb.	1.14	
57, 62, 67, 77	lb.	1.04	
66	lb.	3.00	
Santocure	lb.	.76 /	.78
NS	lb.	.80 /	.82
Selenac	lb.	3.00	
SPDX-GH	lb.	.69 /	.74
GL	lb.	1.20 /	1.34
Sulfads	lb.	1.98	
Tellurac	lb.	1.30 /	1.55
Tepidone	lb.	.45 /	.45
Tetrone A	lb.	1.98	
Thiates	lb.	.88 /	1.25
Thiofide	lb.	.54 /	.56
S	lb.	.64 /	.66
Thionex	lb.	1.14	
Thiotax	lb.	.44 /	.46
Thiurad	lb.	1.14	
Thiuram E	lb.	$1.04	
M	lb.	1.14	
Trimene	lb.	.56 /	$0.62
Base	lb.	1.03 /	1.10
Tuex	lb.	1.14	
Ultex	lb.	1.00 /	1.10
Unads	lb.	1.14	
Ureka Base	lb.	.66 /	.73
Vulcacure NB	lb.	.45	
NS	lb.	.75 /	1.05
T.M.D.	lb.	1.14	
ZB, ZE, ZM	lb.	.85 /	.89
Z-B-X	lb.	2.45 /	2.50
Zenite	lb.	.54 /	.56
A	lb.	.69 /	.71
AM	lb.	.76 /	.78
Special	lb.	.55 /	.57
Zetax	lb.	.51 /	.53
Zimate	lb.	1.04	

Accelerator-Activators, Inorganic

Lime, hydrated	ton	21.96	
Litharge, commL	lb.	.1425/	.1575
Eagle, sublimed	lb.	.1435	
National Lead, sublimed	lb.	.1435	
Red lead, commL	lb.	.185 /	.195
Eagle	lb.	.1475	
National Lead	lb.	.1475/	.1495
PRD-90	lb.	.38 /	.50
White lead, carbonate	lb.	19 /	.20
Eagle	lb.	.17 /	.18
National Lead	lb.	.175 /	.185
Silicate	lb.	.1725/	.1825
Eagle	lb.	.1575/	.22
National Lead	lb.	.1625/	.1725
Zinc oxide, commL†	lb.	.145 /	.1925

Accelerator-Activators, Organic

Aktone	lb.	.2125/	.2325
Barak	lb.	.65	
Capital 170	lb.	.20 /	.25
171	lb.	.1425/	.1925
255, 258, 710	lb.	.14 /	.19
270	lb.	.1175/	.1425
261	lb.	.155 /	.18
262	lb.	.16 /	.185
263	lb.	.1775/	.2025
Curade	lb.	.57 /	.59
D-B-A	lb.	1.95	
Emery 600	lb.	.1425/	.1925
G-M-F	lb.	2.60 /	2.65
PDD-70	lb.	2.70 /	3.00
PGD-25	lb.	1.25 /	1.50
Groco 30	lb.	.1425/	.1925
35	lb.	.1475/	.1975
Guantal	lb.	.62 /	.64
Hyfac 410	lb.	.1525/	.1775
430	lb.	.18 /	.205
431	lb.	.2025/	.2275
Hystrene S-97	lb.	.1863/	.2125
T 45	lb.	.1638/	.19
T-70	lb.	.1738/	.20
Industrene B	lb.	.1263/	.1525
R	lb.	.1138/	.14
158	lb.	.1313/	.1575
254	lb.	.1413/	.1675
262	lb.	.1513/	.1775
Laurex	lb.	.34 /	.38
MODX	lb.	.295 /	.345
NA-22	lb.	1.05	
PND-70	lb.	1.35 /	1.60
Oleic acid, commL	lb.	.185 /	.225
Emersol 210 Elaine	lb.	.1475/	.1975
Groco 2, 4, 8, 18	lb.	.14 /	.195
Welcoline	lb.	.21 /	.42
Plastone	lb.	.27 /	.30
Polyac	lb.	1.85	
Ridacto	lb.	.25 /	.26
Seedine	lb.	.1485/	.1703
Stearex Beads	lb.	.1488/	.1588
Stearic acid			
Emersol 120	lb.	.1675/	.1925
150	lb.	.1925/	.2175
Hydrofoil 51	lb.	.09	
Hydrogenated, rubber grd.			
Groco 56	lb.	.1225/	.1475
Rufat 75	lb.	.1062/	.1325
Single pressed, commL	lb.	.1475/	.1675
Emersol 110	lb.	.1625/	.1875
Groco 54	lb.	.16 /	.185
Wilmar 253	lb.	.1525/	.1775
Double pressed, commL	lb.	.1525/	.1725
Groco 54	lb.	.165 /	.19
Wilmar 254	lb.	.1575/	.1825
Triple pressed, commL	lb.	.175 /	.195
Groco 55	lb.	.1775/	.2025
Wilmar 255	lb.	.1875/	.2075
Sterene 60-R	lb.	.09 /	.1075
Tonox	lb.	.515 /	.605
Vimbra	lb.	.32 /	.385
Vulklor	lb.	.88 /	1.08
Wilmar 110	lb.	.17 /	.22
434	lb.	.1425/	.1925
Zinc stearate, commL	lb.	.39 /	.44

Antioxidants

AgeRite Alba	lb.	2.40 /	2.50
Gel	lb.	.70 /	.72
AgeRite H. P	lb.	$0.79 /	$0.8
Hipar	lb.	1.05 /	1.07
Powder	lb.	.57 /	.59
Age Resin	lb.	.88 /	.90
D	lb.	.57 /	.59
Spar	lb.	.57 /	.59
Stalite	lb.	.57 /	.59
S	lb.	.57 /	.59
Superlite	lb.	.57 /	.59
White	lb.	1.50 /	1.60
Akroflex C	lb.	.85 /	.87
CD	lb.	.79 /	.81
Albasan	lb.	.69 /	.73
Alcogard 354 Powder	lb.	1.50 /	1.52
Allied AA 1144	lb.	.23 /	.24
AA-1177	lb.	.155 /	.165
Aminox	lb.	.57 /	.62
Antioxidant 425	lb.	2.47 /	2.50
2246	lb.	1.50 /	1.53
Antisol	lb.	.23 /	.24
Antisun	lb.	.15 /	.51
Antox	lb.	.59 /	.61
Aranox	lb.	3.25 /	3.30
Betanox Special	lb.	.91 /	.96
B-L-E, -25	lb.	.57 /	.62
Burgess Antisun Wax		.185	
B-X-A	lb.	.55 /	.60
CAO-1	lb.	.37 /	.86
-5	lb.	1.49 /	1.63
Copper Inhibiter X-872-L	lb.	2.01	
D-B-P-C	lb.	.91 /	1.16
Deenax	lb.	.95	
Flectol H	lb.	.57 /	.59
Flexamine	lb.	.79 /	.84
Heliozone	lb.	.31 /	.32
Ionol	lb.	.91 /	1.65
Microflake	lb.	.20 /	.24
Naugawhite	lb.	.57 /	.62
NBC	lb.	1.67	
Neozone A	lb.	.64 /	.66
C	lb.	.86 /	.88
D, Special	lb.	.57 /	.59
Nevastain A	lb.	.51 /	.61
B	lb.	.51 /	.70
Nonox CI	lb.	1.50 /	1.67
WSL	lb.	1.50 /	1.60
WSP	lb.	1.47 /	1.60
Octamine	lb.	.57 /	.62
PDA-10	lb.	.46 /	.48
Perflectol	lb.	.61 /	.68
Permalux	lb.	2.25	
Polygard	lb.	.57 /	.62
Polylite	lb.	.55 /	.60
Protector	lb.	.26 /	.31
Rio Resin	lb.	.60 /	.62
Santoflex 35	lb.	.72 /	.79
75	lb.	1.01 /	1.03
AW	lb.	.71 /	.78
B	lb.	.52 /	.59
BX	lb.	.63 /	.70
DD	lb.	.57 /	.59
Santovar A	lb.	1.55 /	1.57
Santowhite Crystals, Powder	lb.	1.55 /	1.62
L	lb.	.57 /	.59
MK	lb.	1.25 /	1.32
Stabilite	lb.	.55 /	.59
Alba	lb.	.72 /	.79
L	lb.	.60 /	.64
White	lb.	.52 /	.60
Powder	lb.	.41 /	.47
Styphen L	lb.	.51 /	.55
Sunolite #100	lb.	.21 /	.23
#127	lb.	.17 /	.19
Sunproof-713	lb.	.26 /	.31
Improved	lb.	.25 /	.30
Jr	lb.	.22 /	.27
Tenamene 3	lb.	.91 /	1.05
Thermoflex	lb.	1.05 /	1.07
Tonox	lb.	.54 /	.59
Tysonite	lb.	.24 /	.2475
Velvapex 51-250	lb.	.40 /	
V-G-B	lb.	.75 /	.80
Wing-Stay S, T	lb.	.55 /	.67
100	lb.	1.00 /	1.08
Zalba	lb.	1.10	
Zenite	lb.	.52 /	.54

Antiozonants

Eastozone 30, 31	lb.	1.05 /	1.09
Flexone 6-H	lb.	1.25	
Tenamene 30, 31	lb.	1.24 /	1.28
UOP 88, 288	lb.	1.05 /	1.07

Antiseptics

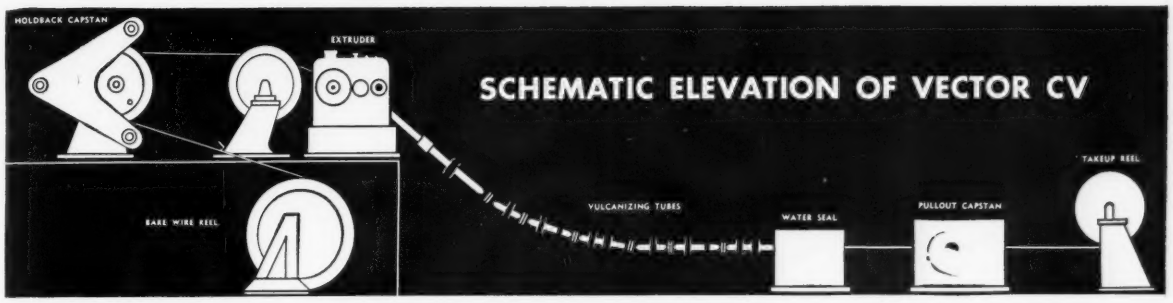
Copper naphthenate, 6-8%	lb.	.245	
Pentachlorophenol	lb.	.22 /	.30
Resorcinol, technical	lb.	.775 /	.785
Zinc naphthenate, 8-10%	lb.	.245 /	.30

Blowing Agents

Ammonium bicarbonate	lb.	.07 /	.09
Carbonate	lb.	.16	
Blowing Agent CP 1475	lb.	.32 /	.35
Celogen	lb.	1.95 /	2.00
50 C	lb.	1.01 /	1.07
Kempore R-125	lb.	1.92	
Opex 40	lb.	.72 /	.72
PL-80	lb.	1.44 /	1.44
Sodium bicarbonate	100 lbs.	2.55 /	3.85
Carbonate, tech.	100 lbs.	1.35 /	5.52
Sponge Paste	lb.	.20	
Unicel ND	lb.	.72	
NDX	lb.	1.44	
S	lb.	.20	
Vulcacel BN	lb.	1.36 /	1.51
BMC	lb.	.68 /	.79

* Prices, in general, are f.o.b. works. Range indicates grade or quantity variations. No guarantee of these prices is made. Spot prices should be obtained from individual suppliers.

† For trade names, see Color—White, Zinc Oxides.



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- **ECONOMY**—Easily installed without extensive—and expensive—plant alterations.
- **COMPLETE** electrical control.

NEW: - "CONSTANT PRESSURE" ROLLER HOPPER

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Bonding Agents

Braze	gal.	$6.00 /	$9.00
Cover cement	gal.	2.50 /	4.00
Chemlok 201, 203	gal.	5.00 /	7.50
220	gal.	9.25 /	12.00
401	gal.	11.70 /	14.40
Chemlok 602	gal.	25.00 /	26.00
607	gal.	18.00 /	
614	lb.	4.35 /	4.75
Flocking Adhesive RFA17, RFA22, RFA25	lb.	.50	
G-E Silicone Paste SS-15	lb.	4.52 /	5.10
SS-64	lb.	3.65 /	6.75
-67 Primer	lb.	7.50 /	12.50
Gen-Tac Latex	lb.	.70 /	.805
Hylene M	gal.	3.50 /	3.75
M-50	gal.	1.90 /	2.15
Kalabond Adhesive	gal.	6.50 /	16.00
Tie Cement	gal.	2.00 /	5.60
Thixons	gal.	1.48 /	12.00
Ty Ply, BN, Q, S, UP, 3640	gal.	6.75 /	8.00
RC	gal.	3.75 /	5.00

Brake Lining Saturants

BRT 3	lb.	.018 /	.0265
Resinex L-S	lb.	.0225/	.03

Carbon Blacks‡

Conductive Channel—CC

Continental R-40	lb.	.23 /	.30
Kosmos/Dixie BB	lb.	.23 /	.30
Spheron C	lb.	.18 /	.24
Voltex	lb.	.18 /	.315

Easy Processing Channel—EPC

Collocarb EPC	lb.	.059 /	.099
Continental AA	lb.	.074 /	.1225
Kosmobile 77/Dixiedensed 77	lb.	.074 /	.1225
Micronex W-6	lb.	.0725/	.155
Spheron #9	lb.	.0775/	.155
Texas E	lb.	.0775/	.145
Witco #12	lb.	.074 /	.1225
Wyex EPC	lb.	.0725/	.155

Hard Processing Channel—HPC

Continental F	lb.	.074 /	.1225
HX HPC	lb.	.074 /	.1225
Kosmobile S/Dixiedensed S	lb.	.074 /	.1225
Micronex Mk. II	lb.	.0775/	.145
Witco #6	lb.	.074 /	.1225

Medium Processing Channel—MPC

Arrow MPC	lb.	.0725/	.155
Continental A	lb.	.074 /	.1225
Kosmobile S-66/Dixiedensed S-66	lb.	.0775/	.145
Micronex Standard	lb.	.0725/	.155
Spheron #6	lb.	.0775/	.155
Texas M	lb.	.0775/	.145
Witco #1	lb.	.074 /	.1225

Conductive Furnace—CF

Aromex CF	lb.	.0875/	.155
Vulcan C	lb.	.110 /	.185
SC	lb.	.18 /	.255
XC-72	lb.	.25 /	.34

Fast Extruding Furnace—FEF

Arovel FEF	lb.	.0625/	.135
Continex FEF	lb.	.06 /	.10
Kosmos 50/Dixie 50	lb.	.06 /	.10
Philblack A	lb.	.0625/	.135
Statex M	lb.	.0625/	.135
Sterling SO	lb.	.0675/	.125

Fine Furnace—FF

Statex B	lb.	.0675/	.14
Sterling 99	lb.	.0725/	.14

High Abrasion Furnace—HAF

Aromex HAF	lb.	.0725/	.145
Continex HAF	lb.	.079 /	.125
Kosmos 60/Dixie 60	lb.	.079 /	.1175
Philblack O	lb.	.0725/	.145
Statex R	lb.	.0725/	.145
Vulcan #3	lb.	.0775/	.145

Intermediate Super Abrasion Furnace—ISAF

Aromex ISAF	lb.	.0875/	.16
Kosmos 70/Dixie 70	lb.	.10 /	.145
Philblack I	lb.	.0875/	.16
Statex 125	lb.	.0875/	.16
Vulcan 6	lb.	.0925/	.16

Super Abrasion Furnace—SAF

Philblack E	lb.	.115 /	.19
Statex 160	lb.	.11 /	.19
Vulcan 9	lb.	.115 /	.19

General-Purpose Furnace—GPF

Arogen GPF	lb.	.055 /	.1275
Statex G	lb.	.055 /	.1275
Sterling V	lb.	$0.06 /	$0.1275
V Non-staining	lb.	.06 /	.1275

High Modulus Furnace—HMF

Collocarb HMF	lb.	.045 /	.085
Continex HMF	lb.	.055 /	.095
Kosmos 40/Dixie 40	lb.	.055 /	.095
Modulex HMF	lb.	.0575/	.13
Statex 93	lb.	.0575/	.13
930	lb.	.047 /	.087
Sterling L, LL	lb.	.0625/	.13

Semi-Reinforcing Furnace—SRF

Collocarb SRF	lb.	.042 /	.082
Continex SRF	lb.	.045 /	.085
Essex SRF	lb.	.0525/	.125
Furnex	lb.	.0525/	.125
Gastex	lb.	.0625/	.135
Kosmos 20/Dixie 20	lb.	.045 /	.085
Pelletex, NS	lb.	.0575/	.125
Sterling NS, S	lb.	.0575/	.125
R	lb.	.0625/	.135

Fine Thermal—FT

P-33	lb.	.0575	
Sterling FT	lb.	.0575	

Medium Thermal—MT

Sterling MT	lb.	.04	
Non-staining	lb.	.05	
Thermax	lb.	.04	
Stainless	lb.	.05	

‡ At the request of the suppliers, the lowest prices shown for carbon blacks are for carloads in bags. Prices for hopper carloads are lower.

Colors

Black

Iron oxides, comml.	lb.	.1235/	.135
BK—Lansco	lb.	.1275/	.13
Williams	lb.	.145	
Lansco synthetic	lb.	.10	
Mapico pure synthetic	lb.	.1475/	.15
Lampblack, comml.	lb.	.16 /	.45
Superjet	lb.	.085 /	.12
Permanent Blue	lb.	.80 /	1.05
Stan-Tone	lb.	.45 /	1.20
Vansul masterbatch	lb.	.60 /	.65
Paste	lb.	.14 /	.15

Blue

Alkali Blue G, R	lb.	2.38	
C. P. Iran Blues	lb.	.52 /	.54
Du Pont	lb.	2.55 /	4.75
Filo	lb.	.28	
Heveatex pastes	lb.	.80 /	1.45
Lansco ultramarines	lb.	.25 /	.28
Monsanto Blue 7	lb.	1.55	
11	lb.	3.45	
DPB-283	lb.	1.93	
S-11	lb.	2.05	
Permanent Blue	lb.	.80 /	1.05
Stan-Tone Violet Blue			
D-4000	lb.	3.45	
4001	lb.	3.00	
4002	lb.	.90	
4900	lb.	1.97 /	2.15
Vansul masterbatch	lb.	.90 /	2.70

Brown

Filo	lb.	.13	
Iron oxides, comml.	lb.	.1425/	.145
Lansco synthetic	lb.	.125	
Mapico Brown	lb.	.1575/	.16
Sienna, burnt, comml.	lb.	.0425/	.155
Williams	lb.	.115 /	.1775
Raw, comml.	lb.	.045 /	.1325
Williams	lb.	.08 /	.1725
Umber, burnt, comml.	lb.	.06 /	.07
Williams	lb.	.0725/	.085
Raw, comml.	lb.	.0625/	.07
Williams	lb.	.07 /	.0825
Williams, pure brown	lb.	.155	
Vandyke	lb.	.12	
Mapico Tan	lb.	.2325/	.235
Metallic brown pure synthetic	lb.	.05 /	.06
Vansul masterbatch	lb.	2.10 /	2.20

Green

Chrome	lb.	.19 /	.50
Green	lb.	.80 /	2.40
Oxide	lb.	.3925/	1.10
Cyanamid	lb.	.42 /	.44
Green G	lb.	3.00	
Lincoln Green	lb.	5.30 /	6.60
G-4099, -6099	lb.	.4525	
GH-9869	lb.	1.10 /	1.25
9976	lb.	1.20 /	1.35
Du Pont	lb.	2.05 /	2.80
Filo	lb.	.40	
Heveatex pastes	lb.	.95 /	1.85
Lansco Toner	lb.	1.35	
Monsanto Green 3	lb.	2.75	
14	lb.	1.45	
17	lb.	3.95	
71205	lb.	1.35	
DGP	lb.	2.03	
S-17	lb.	2.25	
Stan-Tone			
D-5000	lb.	3.95	
5001	lb.	.82	
5400	lb.	1.45	
Vansul masterbatch	lb.	2.00 /	2.60

Orange

Cyanamid Permatons	lb.	1.50 /	1.56
Du Pont	lb.	2.25	
Monsanto Orange 68187	lb.	2.90	
Stan-Tone			
Light orange D-7003	lb.	$3.97 /	$4.17
70 PCO3	lb.	2.48 /	2.76
Orange 70 PCO4	lb.	2.80 /	3.08
D-7004	lb.	4.23 /	4.43
D-7104	lb.	1.85 /	2.05
Vansul masterbatch	lb.	2.00 /	2.60

Red

Antimony trisulfide	lb.	.285 /	.315
R. M. P. No. 3	lb.	.72	
Sulfur Free	lb.	.78	
Brilliant Toning Red	lb.	1.95	
Cadmium red lithopones	lb.	2.21 /	3.77
Cadmolith	lb.	1.72 /	2.20
Cyanamid	lb.	.93 /	1.90
Naphthol Red, Scarlet	lb.	2.95 /	3.80
Du Pont	lb.	2.00 /	2.05
Filo	lb.	.11	
Indian Red	lb.	.1275	
Iron oxide, comml.	lb.	.06 /	.13
Lansco synthetic	lb.	.1175	
Mapico pure synthetic	lb.	.1425/	.145
Recco	lb.	.12	
Williams Red	lb.	.13 /	.1525
Monsanto Maroon 113	lb.	1.50	
61148	lb.	1.75	
Red 7	lb.	1.55	
41	lb.	4.40	
3501	lb.	1.15	
4004	lb.	1.50	
69191	lb.	3.38	
Autumn	lb.	1.10	
PRP-285	lb.	1.27	
S-44	lb.	1.28	
Rub-Er-Red	lb.	.0975	
Stan-Tone			
D-2000	lb.	1.25	
2110, 2120, 2121	lb.	.98	
2200	lb.	1.47	
2500	lb.	1.90	
2600	lb.	4.60	
2601	lb.	1.60	
2700	lb.	1.75	
2800	lb.	1.90	
Light Red D-7005	lb.	4.68 /	4.88
D-7105	lb.	1.97 /	2.17
70 PCO5	lb.	3.00 /	3.28
Red D-7006	lb.	4.89 /	5.09
D-7106	lb.	2.20 /	2.40
70 PCO6	lb.	3.35 /	3.63
Vansul masterbatch	lb.	.95 /	3.30
Venetian	lb.	.04 /	.0675

White

Antimony oxide	lb.	.27 /	.285
Burgess Iceberg	ton	50.00 /	80.00
Cryptone BT	lb.	.10 /	.11
Permolith lithopone	lb.	.08 /	.087
Titanium pigments			
Horse Head Anatase	lb.	.255 /	.27
Rutile	lb.	.275 /	.29
Rayox LW	lb.	.195 /	.205
R-110	lb.	.215 /	.225
Ti-Cal	lb.	.075 /	.0825
Ti-Pure	lb.	.195 /	.225
Titanox A, AA, A-168	lb.	.255 /	.265
C-50	lb.	.1438/	.1488
RA, -10, -50	lb.	.275 /	.285
RC	lb.	.0963/	.1013
-HT, -HTX	lb.	.0963/	.0988
Unitane	lb.	.255 /	.29
Zopaque Anatase	lb.	.245 /	.27
Rutile	lb.	.205 /	.29
Zinc oxide, comml.	lb.	.145 /	.1825
Azo ZZZ-11, -44, -55	lb.	.145 /	.165
20% leaded	lb.	.1505/	.1705
35% leaded	lb.	.155 /	.175
50% leaded	lb.	.1588/	.1788
Eagle AAA, lead free	lb.	.145 /	.155
5% leaded	lb.	.145 /	.155
35% leaded	lb.	.1513/	.1613
50% leaded	lb.	.1538/	.1638
Florence Green Seal	lb.	.1625/	.1725
Red Seal	lb.	.1575/	.1675
White Seal	lb.	.1675/	.1775
Horsehead XX-4, -78	lb.	.145 /	.155
Kadox-15, -17, -72, -515	lb.	.143 /	.155
-25	lb.	.1675/	.1775
Lehigh, 35% leaded	lb.	.1513/	.1613
50% leaded	lb.	.1538/	.1638
Protox-166, -167	lb.	.145 /	.155
St. Joe, lead free	lb.	.145 /	.175
Zinc sulfide, comml.	lb.	.253 /	.263
Cryptone ZS	lb.	.253 /	.263

Yellow

Cadmium yellow lithopones	lb.	1.12 /	1.15
Cadmolith	lb.	1.12 /	1.20
Cyanamid Hansa Yellow	lb.	2.20	
Du Pont	lb.	2.25	
Filo	lb.	.10	
Iron oxide, comml.	lb.	.0525/	.1175
Lansco synthetic	lb.	.1075	
Mapico pure synthetic	lb.	.12 /	.1275
Williams	lb.	.115 /	.1225
Monsanto Yellow 14	lb.	1.91	
10010	lb.	1.91	
BYP-282	lb.	1.21	
GA	lb.	2.45	
S-10010	lb.	1.17	
Stan-Tone			
D-1100	lb.	2.55	
1101	lb.	.69	
Lemon 70 PCO1	lb.	1.77 /	2.19
D-7001	lb.	2.80 /	3.00
Medium yellow 70 PCO2	lb.	1.79 /	2.21
D-7002	lb.	2.98 /	3.18
Vansul masterbatch	lb.	.95 /	1.95
Williams Ocher	lb.	.0575/	.06

HOGGSON

"DUMBBELL" Test Strip Die D412(51T)

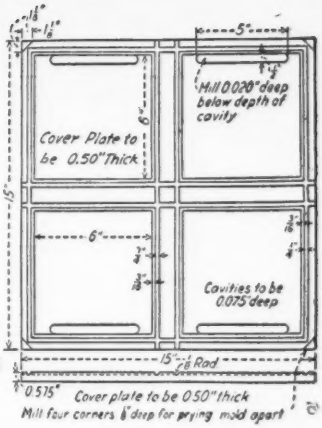
BENCH MARKER

1" and 2" Centers

MALLET HANDLE DUMBBELL DIE

TOOLS, MOLDS, DIES
For Rubber Testing and Production

For making tensile test samples, we make many types of slab molds. One is detailed at the right. These are plain or chrome finished. We usually stock molds for making adhesion, abrasion, flexing, compression and rebound test samples, but supply special molds promptly. We also furnish hand-forged tensile dies for cutting regular or tear test samples.


5"
Mill 0.020" deep below depth of cavity
Cover Plate to be 0.50" Thick
6"
Cavities to be 0.075 deep
15" 2⅛ Rad
0.515" Cover plate to be 0.50" thick
Mill four corners ⅛" deep for prying mold apart

SLAB→ MOLD D15-55

HOGGSON & PETTIS MFG. CO., 141S Brewery St., New Haven 7, Conn.
Pac. Coast: H. M. Royal, Inc., Downey, Calif.

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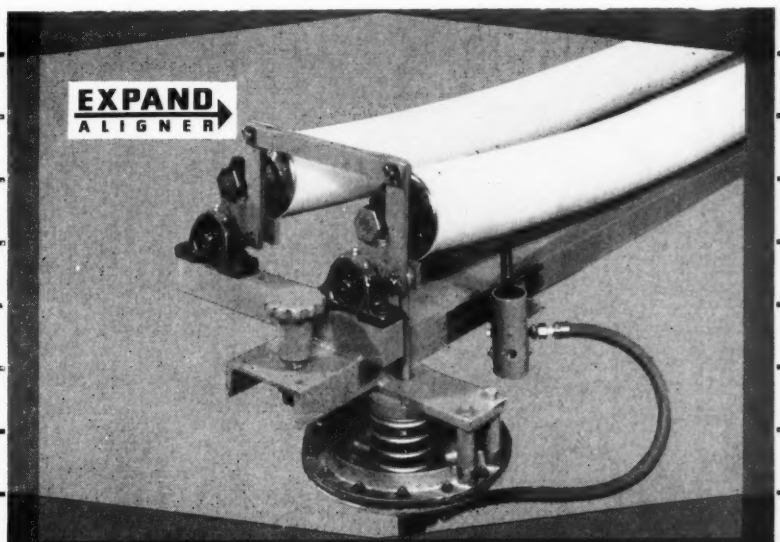

ROLL CAMBER ADJUSTED BY FABRIC EDGE GAGE FOR PRECISE CONTROL OF WIDTH, CENTERING AND EDGE CONDITION OF TIRE FABRICS AND OTHER OPEN WEAVES DURING WEB PROCESSING . . . *Bulletin on Request*

C. A. LITZLER CO., INC.

1817 BROOKPARK RD. CLEVELAND 9, OHIO CABLE "CALITZ"

EXPORT REPRESENTATIVE: GILLESPIE & CO. OF N. Y., 96 WALL ST., NEW YORK 5, N. Y.

Dusting Agents

Antidust	lb.	$0.405	$0.445
Diatomaceous silica	ton	32.00	48.00
Extrud-o-Lube, conc.	gal.	1.33	1.69
Glycerized Liquid Lubricant, concentrated	gal.	1.25	1.63
Latex-Lube GR	lb.	.20	
Pigmented	lb.	.1825	
R-66	lb.	.165	
Liqui-Lube	lb.	.1625	
N. T.	lb.	.1675	
Liquisine No. 305	lb.	.30	.35
Lubrex	lb.	.25	.30
Mica, 160 Biotite	lb.	.065	.0725
Mesh	lb.	.08	.0875
325 Mesh	lb.	.0825/	.09
Concord	lb.	.08	.09
Mineralite	ton	45.00	
Pyrax A	ton	14.50	15.00
W. A.	ton	17.00	17.50
Talc, comml.	ton	18.40	38.50
EM	ton	11.00	63.00
LS Silver	ton	29.25	
Nytals	ton	25.00	36.00
Sierra Sagger 7	ton	34.00	
White IR	ton	19.75	
III	ton	20.75	
Vanfre	gal.	2.00	

Extenders

BRS 700	lb.	.02	.036
BRT 7	lb.	.035	.036
Cumar Resins	lb.	.065	.17
Dielex B	lb.	.06	
Factice, Amberex	lb.	.29	.36
Brown	lb.	.1425/	.263
Neophax	lb.	.157	.268
White	lb.	.144	.285
G. B. Asphaltenes	lb.	.097	.177
Millex, W	lb.	.07	
Mineral Rubbers			
Black Diamond	ton	38.00	40.00
Hard Hydrocarbon	ton	46.50	48.50
Hydrocarbon MR	ton	45.00	55.00
Parmr	ton	21.00	29.00
T-MR Granulated	ton	47.50	50.00
Nuba No. 1, 2	lb.	.0575/	.0625
3X	lb.	.0775/	.0825
OPD-101	lb.	.26	
Rubber substitute, brown	lb.	.16	.2572
Car-Bel-Ex A	lb.	.14	
Car-Bel-Lite	lb.	.35	
Extender 600	lb.	.1765	
White	lb.	.192	.2103
Stan-Shells	ton	35.00	73.00
Sublac Resin PX-5	lb.	.215	.235
Sundex 53	gal.	.12	
85	gal.	.1725	
Synthetic 100	lb.	.41	
Vistanex	lb.	.35	.475

Fillers, Inert

Agrashell flour	ton	50.00	74.00
Albacar	ton	55.00	75.00
Barytes, floated, white	ton	49.00	70.85
Off-color, domestic	ton	25.00	
No. 1	ton	55.00	77.50
2	ton	50.00	72.50
Sparmite	ton	95.00	117.00
Blanc fixe	ton	100.00	165.00
Burgess Iceberg	ton	50.00	80.00
Pigment #20	ton	35.00	60.00
#30	ton	37.00	60.00
HC-75	ton	12.00	30.00
-80	ton	14.00	32.00
WP #1	ton	11.00	16.00
Camel-Carb	ton	14.00	
-Tex	ton	22.00	
-Wite	ton	35.00	
Cary #200	ton	30.00	55.00
Citrus seed meal	lb.	.04	
Oil	lb.	.15	
Clays			
A. F. D. Filler	ton	29.50	36.00
Aiken	ton	14.00	
Albacar	ton	50.00	55.00
Aluminum Flake, coarse	ton	25.50	28.50
Fine	ton	29.50	36.00
#5	ton	27.50	34.50
Champion	ton	14.50	
Crown	ton	14.00	33.00
Dixie	ton	14.50	
Franklin	ton	13.50	35.25
GK Soft Clay	ton	11.00	
Harwick	ton	21.50	77.00
Hi-White R	ton	14.50	19.50
Hydratex R	ton	28.00	
Kaolloid	ton	10.50	
LGB	ton	17.50	
LGP	ton	20.00	
McNamee	ton	14.50	
RX-43	ton	33.00	
Natka 1200	ton	12.00	35.00
Par	ton	13.00	
Paragon	ton	14.50	19.50
Polyfil	ton	25.00	45.00
Recco	ton	14.00	
Sno-Brite	ton	12.50	
Stan-Clay	ton	28.00	
Stellar-R	ton	50.00	
Suprex	ton	14.50	19.50
Swanee	ton	12.50	
Windsor	ton	14.00	30.00
DC Silica	lb.	1.15	1.40
Diatomaceous silica	ton	32.00	48.00
Flocks			
Cotton, dark	lb.	.095	.135
Dyed	lb.	.55	.60
White	lb.	.13	.33
Fabrifil X-24-G	lb.	$0.135	
X-24-W	lb.	.235	
Filfloc 6000	lb.	.33	
F-40-900	lb.	.135	
HSC #35 Silicone Emulsion	lb.	1.22	$ 2.46
Hydrite	ton	25.00	50.00
Kalite	ton	52.50	67.50
Lithopone, comml.	lb.	.075	.085
Astrolith	lb.	.068	.0675
Eagle	lb.	.0725/	.075
Permolith	lb.	.08	.0875
Sunolith	lb.	.075	.0825
Mica, 160 Biotite	lb.	.065	.0725
Mesh	lb.	.08	.0875
325 Mesh	lb.	.0825/	.09
Concord	lb.	.08	.09
Millical	ton	38.00	53.00
Mineralite	ton	40.00	60.00
Non-Fer-Al	ton	35.00	50.00
Ohio Superspray lime	ton	16.50	
Pulverized limestone, Stonelite	ton	8.25	11.00
Purecal	ton	56.75	71.75
Pyrax A	ton	13.50	
W. A.	ton	16.00	
Sawdust	ton	14.00	35.00
Silversheen Mica	lb.	.08	.09
StanWhite	ton	10.50	13.10
Super-White Silica	ton	25.00	46.50
Surfex	ton	37.50	52.50
MM	ton	42.00	57.00
Suspenso	ton	38.00	53.00
Ti-Cal	lb.	.0675	
Valron Estersil	lb.	2.00	2.25
Walnut shell flours	ton	50.00	84.00
Whiting, limestone			
Atomite	ton	32.50	35.00
Calcite	ton	23.00	
Calwhite	ton	20.00	27.00
-T	ton	23.00	
Duramite	ton	20.00	
Gamaco	ton	32.50	40.00
Keystone	ton	20.00	22.00
Laminar	ton	30.00	
No. 10 White	ton	11.00	16.50
Omya	ton	30.00	
BSH	ton	45.00	
Paxinosa	ton	14.50	22.50
Snowflake	ton	17.00	18.00
Witco	ton	13.00	
York	ton	9.50	

Finishes

Apex Bright Finish #5200-E	lb.	.25	
Rubber Finish	gal.	2.50	
Black-out	gal.	4.50	8.00
Flocks, Rayon, colored	lb.	.90	1.50
White	lb.	.75	1.25
Also see Flocks, under Fillers, Inert			
Paraffiint RG and RGU Synthetic Wax	lb.	.15	.22
Rubber lacquer, clear	gal.	1.00	2.00
Shellacs, Angelo	lb.	.485	.7325
Vac Dry	lb.	.485	.57
Talc (*See Talc, under Dusting Agents*)			
Unidip	lb.	.15	.20
Wax, Bees	lb.	.68	.83
Carnauba	lb.	.57	1.13
Monten	lb.	.27	
No. 118, colors	gal.	.86	1.41
Neutral	gal.	.76	1.31
Van Wax	gal.	1.45	1.50

Latex Compounding Ingredients

Acintol D, DLR	lb.	.06	.075
FA #1	lb.	.065	.08
#2	lb.	.075	.09
Accelerator 552	lb.	2.25	
J-117, -302	lb.	1.00	1.15
-144	lb.	.15	.30
-307	lb.	1.10	1.25
-311	lb.	.60	.75
Aerosol, dry types	lb.	.65	.80
Liquid types	lb.	.40	.75
Alcogard 354	lb.	1.40	1.42
Alcogum AK-12	lb.	.12	.14
AN-6	lb.	.055	.06
-10	lb.	.09	.10
-25	lb.	.31	
PA-15	lb.	.16	
Alrosol	lb.	.41	
Amberex solutions	lb.	.1675/	.18
Antifoam J-114	lb.	3.25	3.45
P-242	lb.	.24	.35
Antioxidant J-137, -140	lb.	.55	.70
-139, -293	lb.	1.45	1.60
-182	lb.	2.00	2.15
-186	lb.	1.40	1.55
2246	lb.	1.50	1.53
Anti Webbing Agent J-183	lb.	.75	.90
-297	lb.	.27	.40
Aquablak B	lb.	.0975/	.1025
G	lb.	.12	.125
K	lb.	.12	.125
M	lb.	.105	.11
Aquarex D	lb.	.81	
G	lb.	.21	
L	lb.	.94	
MDL	lb.	.33	
ME	lb.	.80	
Aquarex NS	lb.	.60	
SMO	lb.	.50	
WAQ	lb.	.22	
Areskap 50	lb.	.30	.38
100, dry	lb.	.60	.72
Aresket 240	lb.	.30	.38
300, dry	lb.	.60	.72
Aresklene 375	lb.	$0.42	$0.57
Ben-A-Gels	lb.	.98	1.40
Bentone 18, 18C	lb.	.45	
34	lb.	.60	
Casein	lb.	.22	
Cellosize WP-09, -3, -40			
-300	lb.	1.00	1.17
CW-12		.85	
-37	lb.	.70	
DC Antifoam A Compound	lb.	5.45	6.65
B	lb.	.63	1.10
Emulsion	lb.	2.05	4.00
AF Emulsion	lb.	2.05	2.85
Compound 7	lb.	5.13	6.50
Defoama W-1701	lb.	.125	
Defoamer 115a	lb.	.50	
NDW	lb.	.215	.235
Dispersing Agents			
Blancol	lb.	.1525/	.26
N	lb.	.155	.26
Darvan Nos. 1, 2, 3	lb.	.22	.30
Daxad 11, 21, 23, 27	lb.	.08	.30
Dispersaid H7A	lb.	.58	
1159	lb.	.43	
Emulphor ON-870	lb.	.50	.70
Igepal CO-630	lb.	.2875/	.47
Igepon T-73	lb.	.285	.495
T-77	lb.	.45	.69
Indulins	lb.	.06	.08
Kreelons	lb.	.132	.155
Laurelton Oil	lb.	.18	
Leonil SA	lb.	.52	.65
Lomar PW	lb.	.18	
Marasperse CB	lb.	.1225/	.1425
N	lb.	.095	.105
Modicols	lb.	.17	.58
Nekal BA-75	lb.	.395	.54
BX-76	lb.	.63	.75
Nopco 1287	lb.	.155	.195
Orzan A	lb.	.0325	
S	lb.	.0425	
Pluronics	lb.	.335	.40
Polyfons	lb.	.08	.09
Sorapon SF-78	lb.	.28	.40
Tergitol NPX	lb.	.275	.3074
TMN	lb.	.2875/	.32
7	lb.	.4125/	.44
Trenamine W-30	lb.	.15	
W-40	lb.	.60	.75
Triton R-100	lb.	.12	.25
X-100, -102, -114	lb.	.255	.36
Dispersions			
Agebest 1293-22	lb.	1.90	2.00
AgeRite Alba	lb.	3.00	
Powder, Resin D	lb.	.80	
White	lb.	1.80	
Altax	lb.	.75	
Shield Nos. 2, 6	lb.	.08	
3	lb.	.095	
4-35	lb.	.09	
5	lb.	.093	
7-F, 8	lb.	.165	
55	lb.	.18	
Iron Oxide, 60%	lb.	.40	
L.S.W.	lb.	1.50	
No. 305 Liquizinc	lb.	.30	.35
P-33	lb.	.35	
Rotax	lb.	.75	
Sulfur	lb.	.12	.30
No. 2	lb.	.14	.16
Telloy	lb.	3.00	
Tuads, Methyl	lb.	1.14	
Vulcacure NB	lb.	.45	
NS	lb.	.75	1.05
T.M.D.	lb.	1.14	
ZB, ZE, ZM	lb.	.85	.89
Vulcanizing, C group	lb.	.40	1.30
G group	lb.	.45	.90
N group	lb.	.40	1.00
Zetax		.75	
Zimates, Butyl	lb.	1.04	
Ethyl, Methyl	lb.	1.04	
Zinc oxide	lb.	.40	
Emulsions			
AgeRite Stalite	lb.	.75	
Borden Arcco A-25, A-26, 716-30	lb.	.18	.19
555-40-R	lb.	.185	.205
620-32B	lb.	.20	.21
716-35	lb.	.17	.18
1041-21	lb.	.165	.175
Habuco Resin Nos. 502, 515, 523	lb.	.195	.20
503	lb.	.22	.225
504, 526	lb.	.19	.195
517	lb.	.175	.18
524	lb.	.155	.16
Resin A-2	lb.	.16	.25
P-370	lb.	.175	.25
X-210	lb.	.12	.22
Freeze-Stabilizer 322	lb.	.40	
12116C	lb.	.52	
Hyonic PE 250	lb.	.255	.295
Igepon T-43	lb.	.145	.35
T-51	lb.	.125	.285
-73	lb.	.285	.495
Ludox	lb.	.1675/	.195
Marmix	lb.	.41	.48
Merac	lb.	.75	1.05
Micronex, colloidal	lb.	.06	.072
Modical S	lb.	.3084/	.3284
VD	lb.	.1384/	.1584
Monsanto Blue 4685 WD	lb.	1.60	
Green 4884 WD	lb.	1.80	
Red 127	lb.	1.25	
OPD 101	lb.	.16	.26
Picco Latex Plasticker A-12	lb.	.069	.096
Pliolite Latex 150, 190	lb.	.32	.41
170	lb.	.37	.46
Polyvinyl methyl ether	lb.	.35	.45

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RUBBER CEMENT COMPOUNDER. KNOWLEDGE OF SOLVENT formulations using all synthetics and natural rubber, for use in adhesives, laminants, coatings. Salary open, opportunity unlimited in financially-stable growth company. Location Stamford, Conn. Submit résumé to Director of Research, POLYMER INDUSTRIES, INC., Springdale, Conn.

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CHEMICAL & ENGINEERING TECHNOLOGIST — MANY years' experience in rubber, plastics & latex technology. Extensive pressure-sensitive development and manufacturing experience. Solved many problems in coating, calendering & molding processes. Have been in consulting work, development, and production in other chemical & technical fields. Numerous patents registered. B.S. Chem. with Ph.D. experience level. Mature age; presently employed. Consider new permanent connection or consulting engagements. New Jersey area preferred. Address Box No. 2325, care of RUBBER WORLD.

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4—Blaw Knox 6' x 40' Horizontal Vulcanizers with quick-opening doors, 250# working pressure, ASME.
1—Bolling 3-roll Laboratory Calender, 8" x 16".
2—Royle #½ Extruders, complete.
1—Banbury Midget Mixer with 2-HP gear motor.
1—Farrel-Birmingham 3-roll Lab Calender, 6" x 12".
Address Box No. 2324, care of RUBBER WORLD.

FOR SALE: AT HOUSTON, TEXAS: 12 ADAMSON 16 x 24" presses, 14" ram, four posts, single opening, 6¾" daylight, 150 tons @ 2000#. Two 16 x 42" end-cap Farrel mills. HOUSTON RUBBER MACHINE COMPANY, 3301 Jensen Drive, Houston 26, Texas.

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No. 11 Banbury 2-Speed Mixer. 535/370-HP motor drive.
84" x 26" HEAVY-DUTY MILL with 150-HP drive.
3000-Ton 12-Opening PRESS. Steam Platens 78" x 39" with loader.
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183-189 ORATON ST. CABLE "URME" NEWARK 4, N. J.

Resin V	lb.	$0.13	
Roelgel 100C	lb.	.46	
Santomerse D	lb.	.44 /	$0.65
S	lb.	.13 /	.25
Sellogen Gel	lb.	.1275	
Sequestrene AA	lb.	.905 /	.975
30A	lb.	.245 /	.265
Sequestrene ST	lb.	.585 /	.615
Setsit #5	lb.	.75 /	1.05
D #9	lb.	.85 /	1.15
Stablex A	lb.	.80 /	1.10
B, G	lb.	.50 /	.95
K	lb.	.27 /	.35
P	lb.	.35 /	.50
T	lb.	.14 /	.22
Surfactol 13	lb.	.345 /	.36
Vult-Accel E	lb.	.85 /	.92
Webnix	lb.	1.50 /	2.50

Mold Lubricants

Acintol D	lb.	.06 /	.75
A-C Polyethylene	lb.	.30 /	.47
Alipal CO-433	lb.	.25 /	.45
CO-436	lb.	.22 /	.41
Aquarex Compounds	lb.	.21 /	.94
Carbowax 200, 300, 400	lb.	.22 /	.25
1500	lb.	.255 /	.2825
4000	lb.	.31 /	.32
6000	lb.	.35 /	.36
Castorwax	lb.	.3375/	.3575
Colite Concentrate	gal.	.90 /	1.15
D-Tak Dip #10	gal.	1.50	
DC Mold Release Fluid	lb.	3.14 /	4.75
Compound 4, 7	lb.	5.13 /	6.50
Emulsion 7	lb.	1.20 /	1.74
8, 35, 35A, 35B, 36	lb.	1.20 /	1.74
200 Fluid	lb.	3.14 /	4.75
ELA	lb.	.82	
FT Wax 200	lb.	.265 /	.42
300	lb.	.295 /	.45
Glycerized Liquid Lubricant, concentrated	gal.	1.25 /	1.63
Igepals	lb.	.2875	.74
Igepon AP-78	lb.	.44 /	.68
T-43	lb.	.145 /	.35
-51	lb.	.125 /	.285
-73	lb.	.285 /	.495
Lubrex	lb.	.27 /	.32
Lubri-Flo	gal.	10.00 /	12.05
Lustermold	lb.	.41	
L-41 Diethyl Silicone Oil	lb.	3.50	
Mold Paste	lb.	.25	
Monopole Oil	lb.	.16	
Monten Wax	lb.	.57	
MR-22	gal.	9.95 /	14.95
Para Lube	lb.	.046 /	.048
Paraflint RG and RGU Synthetic Wax	lb.	.15 /	.22
Plaskon 8406, 8407	lb.	.30 /	.37
8416, 8417	lb.	.35 /	.42
8429	lb.	.40 /	.47
Pluronics	lb.	.335 /	.44
Poly-Brite PE-20	lb.	.28 /	.42
600	lb.	.42 /	.58
Poly-Cone 125X	lb.	1.20 /	1.40
1000	lb.	.93 /	1.06
Polyglycol E series	lb.	.29 /	.42
RA-1, -2, -3	gal.	2.25 /	3.00
Rubber Glo	gal.	.94 /	.97
SM-33, -55, -61, -62	lb.	1.22 /	1.76
Soap, Hawkeye	lb.	1.35 /	1.45
Purity	lb.	.155 /	.165
Sodium stearate	lb.	.40	
Stoner's 700 series	gal.	1.20 /	1.25
800 series	gal.	1.26 /	1.70
900 series	gal.	1.55 /	2.55
A Series	gal.	1.80 /	4.50
Ucon 50-HB Series	lb.	.25 /	.375
Ulco	lb.	.12 /	.23
Vanfre	gal.	1.95 /	3.00

Odorants

Alamasks	lb.	.75 /	6.50
Coumarin	lb.	2.95 /	3.55
Curodex 19	lb.	4.75 /	5.05
188	lb.	5.75	
198	lb.	5.75	
Ethavan	lb.	6.75 /	7.35
Latex Perfume #7	lb.	4.00	
Neutroleum Gamma	lb.	3.60	
Rodo	lb.	4.00 /	5.50
Rubber Perfume #10	lb.	2.60	
Vanillin, Monsanto	lb.	3.00 /	3.15

Plasticizers and Softeners

Acintol R	lb.	.065 /	.07
Adipol 2EH, 10A, XX	lb.	.40 /	.435
BCA	lb.	.43 /	.455
ODV	lb.	.43 /	.465
Admex 710	lb.	.3325/	.3625
711	lb.	.3325/	.3825
744	lb.	.3925/	.3825
Aro Lene #1980	lb.	.10 /	.12
Baker AA Oil	lb.	.195 /	.24
Crystal O Oil	lb.	.21 /	.255
Processed oils	lb.	.215 /	.235
Bardol, 639	lb.	.0275/	.0375
B	lb.	.055 /	.065
Benzoflex 2-45	lb.	.26 /	.29
9-88	lb.	.27 /	.30
Bondogen	lb.	.555 /	.605
BRC-20	lb.	.022 /	.0245
22	lb.	.026 /	.0285
30	lb.	.0165/	.025
521	lb.	.023	
BRH 2	lb.	.0341/	.0351
BRS 700	lb.	.036	
BRT 7	lb.	$0.035 /	$0.036
BRV	lb.	.0625/	.065
Bunarex Liquid	lb.	.0425/	.0555
Resins	lb.	.065 /	.1225
Bunnatol G, S	lb.	.40 /	.505
Butac	lb.	.125 /	.135
Butyl stearate, comml.	lb.	.255	
B-17	lb.	.21	.33
Binney & Smith	lb.	.23 /	.26
Harchem	lb.	.2525/	.3425
Kessoflex	lb.	.245 /	.275
Ohio-Apex	lb.	.245 /	.255
Butyl stearate—G. P.	lb.	.0125/	.02
R-100	lb.	.045 /	.0525
TT	lb.	.017 /	.02
Califlux G. P.	lb.	.015 /	.0225
R-100	lb.	.0475/	.0575
T-T	lb.	.019 /	.0295
510, 550	lb.	.0275/	.0375
Capryl alcohol, comml.	lb.	.195 /	.235
Columbian Carbon	lb.	.195 /	.30
Harchem	lb.	.195 /	.30
Chlorowax 40	lb.	.1625/	.1825
70	lb.	.185 /	.245
-S	lb.	.21 /	.27
Circo light	gal.	.17	
Circosol-2XH	gal.	.185	
Contogums	lb.	.0875/	.111
Cumar Resins	lb.	.065 /	.17
DBM (dibutyl-m-cresol) Darex	lb.	.32 /	.3475
DBP (dibutyl phthalate), comml.	lb.	.30 /	.133
Darex	lb.	.30 /	.33
Eastman	lb.	.26 /	.30
Harflex 140	lb.	.26 /	.40
Harwick Std. Chem. Co.	lb.	.325 /	.385
Hatco	lb.	.30 /	.33
Monsanto	lb.	.26 /	.30
Naugatuck	lb.	.30 /	.33
Ohio-Apex	lb.	.30 /	.335
PX-104	lb.	.30 /	.33
Rubber Corp. of America	lb.	.26 /	.44
Sherwin-Williams	lb.	.30 /	.33
DBS (dibutylsebacate) comml.	lb.	.66 /	.69
Eastman	lb.	.68 /	.71
Harflex 40	lb.	.655 /	.745
Hatco	lb.	.66 /	.685
Monoplex	lb.	.66 /	.675
Naugatuck	lb.	.665 /	.69
PX-404	lb.	.665 /	.69
DCP (dicaprylphthalate), comml.	lb.	.295 /	.325
Harflex 180	lb.	.25 /	.39
Hatco	lb.	.295 /	.325
Monoplex	lb.	.30 /	.315
DDA (didecyladipate) Good-rite GP-236	lb.	.40 /	.55
Kessoflex	lb.	.40 /	.435
DDP (didecylphthalate) Good-rite GP-266	lb.	.295 /	.45
Hatco	lb.	.305 /	.435
Defoamer X-3	lb.	.355	
DIBA (diisobutyladipate) Darex	lb.	.4325/	.4625
Eastman	lb.	.40 /	.44
Ohio-Apex	lb.	.41 /	.445
DIDA (diisodecyladipate) Monsanto	lb.	.40 /	.435
RC	lb.	.40 /	.54
DIDP (diisodecylphthalate) Darex	lb.	.32 /	.35
Harflex 110	lb.	.26 /	.40
Monsanto	lb.	.26 /	.30
Ohio-Apex	lb.	.29 /	.325
PX-120	lb.	.305 /	.335
RC	lb.	.26 /	.43
Dielex B	lb.	.06	
Diethylene glycol, comml.	lb.	.1525/	.1825
Wyandotte	lb.	.15 /	.165
Dinopol IDO	lb.	.285 /	.32
DIOA (diisooctyladipate) Harflex 220	lb.	.40 /	.495
Kessoflex	lb.	.40 /	.435
Naugatuck	lb.	.435 /	.465
PX-208	lb.	.425 /	.455
Rubber Corp. of America	lb.	.40 /	.54
DIOP (diisooctylphthalate), comml.	lb.	.305 /	.335
Darex	lb.	.32 /	.35
Eastman	lb.	.28 /	.29
Harflex 120	lb.	.25 /	.39
Hatco	lb.	.305 /	.335
Monsanto	lb.	.25 /	.29
Naugatuck	lb.	.305 /	.335
Ohio-Apex	lb.	.28 /	.315
PX-108	lb.	.305 /	.335
Rubber Corp. of America	lb.	.25 /	.43
Sherwin-Williams	lb.	.32 /	.34
DIOS (diisooctylsebacate), comml.	lb.	.61 /	.64
Rubber Corp. of America	lb.	.5925/	.70
DIOZ (diisooctylazelate) Cabflex	lb.	.48 /	.51
Dipolymer Oil	gal.	.33 /	.38
Dispersing Oil No. 10	lb.	.06 /	.0625
DNODA (di-n-octyl-n-decyl adipate), Monsanto	lb.	.40 /	.435
DOA (dioctyladipate), comml.	lb.	.425 /	.455
Eastman	lb.	.40 /	.43
Good-rite GP-233	lb.	.40 /	.55
Harflex 250	lb.	.40 /	.495
Hatco	lb.	.435 /	.465
Monsanto	lb.	.40 /	.435
Naugatuck	lb.	.435 /	.465
PX-238	lb.	.425 /	.455
Rubber Corp. of America	lb.	.40 /	.54
DOP (dioctylphthalate), comml.	lb.	$0.305 /	$0.335
Darex	lb.	.32 /	.35
Eastman	lb.	.28 /	.315
Good-rite GP-261	lb.	.285 /	.44
Harflex 150	lb.	.25 /	.39
Hatco	lb.	.305 /	.335
DOP (commr.) Monsanto	lb.	.25 /	.29
Naugatuck	lb.	.305 /	.335
Ohio-Apex	lb.	.28 /	.315
Polycizer 162	lb.	.28 /	.435
PX-138	lb.	.305 /	.335
Rubber Corp. of America	lb.	.25 /	.43
Sherwin-Williams	lb.	.305 /	.335
DOS (dioctylsebacate), comml.		.61 /	.64
Eastman	lb.	.61 /	.64
Harflex 50	lb.	.5925/	.6825
Hatco	lb.	.61 /	.635
Monoplex	lb.	.61 /	.635
Naugatuck	lb.	.615 /	.64
PX-438	lb.	.615 /	.64
Rubber Corp. of America	lb.	.5925/	.70
DOZ (di-2-ethylhexyl azelate) Kessoflex	lb.	.46 /	.48
Drapex 3.2	lb.	.40 /	.54
Dutch Boy NL-A10 (DBP)	lb.	.30 /	.33
-A20 (DOP), A30 (DIOP)	lb.	.305 /	.335
-A54	lb.	.295 /	.325
-C20 (DOS)	lb.	.61 /	.63
-F21	lb.	.395 /	.425
-F31	lb.	.44 /	.47
-F41	lb.	.48 /	.51
Dutrex 6	lb.	.025 /	.035
Dymerex Resin	lb.	.135 /	.1475
Elastex 36-R	lb.	.43 /	.4625
37-R	lb.	.70 /	.71
Emulphor EL-719	lb.	.52 /	.73
Endor	lb.	.67	
Ethox	lb.	.43 /	.455
Ethylene glycol, comml.	lb.	.135 /	.165
Wyandotte	lb.	.1325/	.1425
Flexol 3 GH	lb.	.44 /	.46
3 GO	lb.	.53 /	.55
4 GO	lb.	.325 /	.355
10-A	lb.	.425 /	.455
426	lb.	.27 /	.30
810, 810X, 10-10, 10-10X	lb.	.305 /	.335
TOF, A-26	lb.	.435 /	.465
Flexricin P-4	lb.	.3475/	.3625
P-6	lb.	.415 /	.43
P-8	lb.	.3475/	.3625
PG-16	lb.	.335 /	.35
Fortex	lb.	.125 /	.145
Fura-Tone NC 1008	lb.	.28	
1012	lb.	.46	
G. B. Asphaltic Flux	gal.	.097 /	.177
Naphthenic Neutrals	gal.	.125 /	.215
Process oil, light	lb.	.0275/	.0375
Medium	lb.	.0375/	.0475
Galex W-100	lb.	.155 /	.18
W-100 D	lb.	.1525/	.1775
Gilsowax B	lb.	.0975/	.11
Harchemex	lb.	.24 /	.345
Harflex 300	lb.	.58 /	.675
325	lb.	.4325/	.52
375	lb.	.7425/	.83
500	lb.	.315 /	.41
HB-20	lb.	.19 /	.22
-40	lb.	.15 /	.17
Heavy Resin Oil	lb.	.0225/	.0375
HSC-13	lb.	.25 /	.32
-39	lb.	.22 /	.29
Hycar 1312	lb.	.60	
Kapsol	lb.	.33 /	.355
Kenflex A, L	lb.	.26 /	.27
B	lb.	.23 /	.24
N	lb.	.18 /	.19
Kessoflex 103	lb.	.405	
105	lb.	.3325	
106	lb.	.38	
107	lb.	.525	
110	lb.	.24	
111	lb.	.28	
KP-23	lb.	.315 /	.325
-90	lb.	.40 /	.435
-140	lb.	.46 /	.485
-201	lb.	.58 /	.59
-220	lb.	.33 /	.365
-555	lb.	.59 /	.60
Kronisol	lb.	.33 /	.365
Kronitex AA, I, K-3, Mx	lb.	.325 /	.36
LX-685 -125, -135	lb.	.125 /	.135
Marvinol plasticizers	lb.	.28 /	.8825
Methox	lb.	.385 /	.41
Monoplex S-38	lb.	.215 /	.24
S-71	lb.	.45 /	.475
Morflex	lb.	.25 /	.65
Natac	lb.	.12 /	.13
Neoprene Peptizer P-12	lb.	1.05	
Nevillac	lb.	.31 /	.85
Neville R Resins	lb.	.145 /	.205
Nevinol	lb.	.24	
No. 1-D heavy oil	lb.	.065	
NP-10	lb.	.50 /	.53
ODA (octyldecyladipate) Good-rite GP-235	lb.	.40 /	.55
Kessoflex	lb.	.40 /	.435
RC	lb.	.40 /	.54
ODP (octyldecylphthalate) Good-rite GP-265	lb.	.29 /	.445
Hatco	lb.	.305 /	.335
Rubber Corp. of America	lb.	.255 /	.43
Ohopex Q-10	lb.	.28 /	.315
R-9	lb.	.3525/	.3775
Orthonitro benzophenol, comml.	lb.	.13 /	.15

MACHINERY & SUPPLIES FOR SALE (Cont'd.)

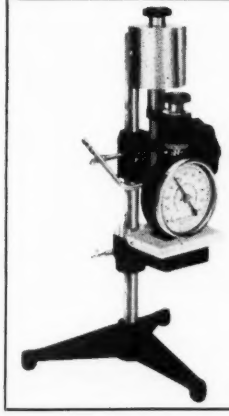
HYDRAULIC PRESSES, 325-TON UPSTROKE 28″ X 28″ 300-TON upstroke 40″ x 30″. 300-Ton upstroke 22″ x 35″. 250-Ton French Oil upstroke 38″ x 28″. 150-Ton Farrel 24″ x 24″. Hartig 3½″ Plastic Extruder, Elect. Heated. NRM 1″ Elect. Heated. MPM 2″ Elect. Heated. Adamson 6″ Rubber Extruder. Thropp 3″ x 8″, two-roll Lab. Mill. New and used Lab. 6″ x 13″, 6″ x 16″, and 8″ x 16″ Mills and Calenders and sizes up to 84″. Baker-Perkins and Day Heavy-Duty Jack. Mixers up to 200 gallons. Hydraulic pumps and accumulators. Ball & Jewell #2 Rotary Cutter and other sizes. Colton 5½T & 4T Preform machines, motor driven. Other sizes in Single-Punch and Rotary types. Banbury Mixers, Crushers, Churns, Tubers, Vulcanizers, Bale Cutters, Gas Boilers, etc. SEND FOR SPECIAL BULLETIN. WE BUY YOUR SURPLUS MACHINERY. STEIN EQUIPMENT COMPANY, 107-8th STREET, BROOKLYN 15, NEW YORK. STERLING 8-1944.

FOR SALE: 5—BAKER-PERKINS 100-GAL. 15 JIM2 JACKETED, Sigma-Blade Mixers; 1—Stewart Bolling 6″ x 12″ Two-Roll Mill; 1—Robinson #1630 Plastic Cutter; 1—Ball & Jewell Rotary Cutter; Powder Mixers; Tablet Presses; Screens. Your inquiries solicited. BRILL EQUIPMENT COMPANY, 2401 Third Ave., New York 51, N. Y.

BANBURY #3 WITH 75-HP MOTOR DRIVE—CAN BE RUN in plant. 22″ x 60″ top cap mill, floor-line installation with 125-HP motor and reducer—see under power.
6″ x 13″ lab mill, completely self-contained with motor in base—still running in plant.
ALSO IN STOCK: Farrel 3″ tuber, Royle #2 and #4 tubers, Holmes rubber slug cutter, 18″ x 40″ three-roll calender. Large assortment of upmoving ram rubber presses, 24″ x 24″ beds and up. 12″ dia. to 30″ dia. ram.
JOHNSON MACHINERY COMPANY
683 Frelinghuysen Avenue Newark 12, New Jersey
BIgelow 8-2500

FOR SALE: 2″ ROYLE TUBER WITH 7½-HP DC MOTOR, V-Belts, Sheaves, Starter, Rheostat. 48″ Dia., 24″ Deep Vertical Vulcanizer, 18 36″-Dia. Aluminum Pans and Spacer. ¼-Ton Electric Hoist, 26 Ft. I-Beam. 8-Ft. Conveyor with ½-HP DC Motor. Shore A-2 Durometer. Ames Comparator. 2″ Allen-Williams, 3¼″ Royle Tubers. PILOT RUBBER COMPANY, 1745 Front Street, Cuyahoga Falls, Ohio.

FOR SALE—1—8″ x 12″ BIRMINGHAM LAB MILL, 10 HP; 1 National Erie 3¼″ extruder; 3 Baker-Perkins mixers, 100, 150, 200 gallons; 3 Lab presses 12″ x 12″ and 15″ x 15″; also mills, mixers, presses, etc. CHEMICAL & PROCESS MACHINERY CORP., 52 Ninth Street, Brooklyn 15, N. Y.



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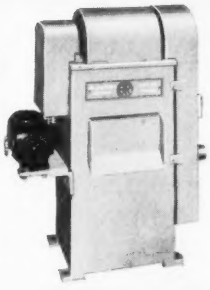
Cutter



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Palmalene	lb.	$0.15	
Panaflex BN-1	lb.	.185 /	$0.225
Panarez Resins	lb.	.09 /	.14
Para Flux, regular	gal.	.10 /	.2125
Para Flux No. 2016	gal.	.165 /	.24
2332	gal.	.11	
4205	gal.	.1075/	.2125
Paralube	lb.	.46 /	.48
Resins	lb.	.04 /	.045
Paradene Resins	lb.	.07 /	.08
Paraplex S-B	lb.	.29 /	.3475
Al-111	lb.	.32 /	.3275
G-25	lb.	.76 /	.77
-40	lb.	.4825/	.51
-50	lb.	.39 /	.4175
-53	lb.	.4325/	.46
-60	lb.	.325 /	.35
-62	lb.	.345 /	.37
RG-7	lb.	.33 /	.335
-8	lb.	.505 /	.5125
-10	lb.	.52 /	.5275
Peptizer 620	lb.	.37	
Peptizer 640	lb.	.42	
Pepton 22	lb.	.83 /	.86
65	lb.	1.23 /	1.26
65-B	lb.	.83 /	.86
Philrich 5	gal.	.125	
Picco Resins	lb.	.1275/	.22
480 Oilproof Series	lb.	.18 /	.23
Aromatic Plasticizers	lb.	.05 /	.065
Liquid Resin D-165 (Y)	lb.	.06 /	.075
(Z-3)	lb.	.07 /	.085
(Z-6)	lb.	.08 /	.095
S. O. S.	gal.	.29 /	.34
Piccocizers	lb.	.04 /	.055
Piccolastic Resins	lb.	.16 /	.25
Piccolyte Resins	lb.	.205 /	.245
Piccopale Resins	lb.	.12 /	.135
Piccovars	lb.	.165 /	.20
Piccovol	lb.	.025 /	.038
Pictar	gal.	.25 /	.30
Pigmentar	lb.	.046 /	.0634
Pigmentaroil	lb.	.046 /	.0634
Pitch, Burgundy, Sunny South	lb.	.1030/	.1085
Plasticizers			
42	lb.	.34 /	.40
84	lb.	.25/	.29
B	lb.	.35 /	.45
DP-520	lb.	.435 /	.455
MP	lb.	.035 /	.0755
MT-511	lb.	.6925/	.7425
ODN	lb.	.35 /	.475
SC	lb.	.38 /	.55
Plastoflex #3	lb.	.52 /	.57
#520	lb.	.36 /	.435
DBE	lb.	.50 /	.55
MGB	lb.	.29 /	.37
SP-2	lb.	.43 /	.48
VS	lb.	.3575/	.3975
Plastogen	lb.	.0875/	.09
Plastone	lb.	.25 /	.32
Polycin 470	lb.	.325 /	.34
Polycizers	lb.	.25 /	.415
162	lb.	.25 /	.405
Polymel-C	lb.	.1775/	.1875
D	lb.	.225 /	.235
D-TAC	lb.	.1975/	.215
DX, C-130	lb.	.1375/	.1475
Poly-Sperse AP-2	lb.	.23 /	.295
AP-300	lb.	.26 /	.325
LC-20	lb.	.26 /	.325
R-100	lb.	.17 /	.235
PT Pine Tars	lb.	.038 /	.0554
101 Pine Tar Oil	lb.	.038 /	.0554
Reogen	lb.	.1425/	.145
Resin C pitch	lb.	.0225/	.031
R6-3	lb.	.38 /	.40
Resinex 10, 25, 50, 110	lb.	.04 /	.045
70	lb.	.0325/	.0375
85, 100	lb.	.035 /	.04
115	lb.	.0375/	.0425
L-2, L-3, L-4, L-5	lb.	.0225/	.03
Rosin Oil, Sunny South	gal.	.58 /	.76
RPA No. 2	lb.	.85	
3	lb.	.51	
Conc.	lb.	.85	
5	lb.	.68	
6	lb.	1.66	
RSN Flux	gal.	.10 /	.91
Rubber Oil B-5	lb.	.0225/	.0355
Rubberol	lb.	.18 /	.2725
Santicizer 1-H	lb.	.50 /	.52
8	lb.	.44 /	.46
9	lb.	.42 /	.44
140	lb.	.325 /	.36
141	lb.	.34 /	.375
160	lb.	.25 /	.29
409	lb.	.39	
602	lb.	.285	
B-16	lb.	.4475/	.4675
E-15	lb.	.51 /	.54
Santocizer	lb.	.4275/	.4575
Sebacic acid, purified, comml.	lb.	.59 /	.65
Binney & Smith	lb.	.64 /	.76
C. P.- Binney & Smith	lb.	.72 /	.84
Harchem	lb.	.655 /	.815
Sherolatum Petroleum	lb.	.05 /	.10
Softener #20	gal.	.10 /	.20
Special Rubber Resin 100	lb.	.1675/	.2175
Staflex AX	lb.	.43	
DBES	lb.	.61 /	.635
Syn-Tac	gal.	.33 /	.35
Synthol	lb.	.17 /	.2625
Tetraflex R-122	lb.	.245 /	.285
Thiokol TP-90B	lb.	.59	
-95	lb.	.65	
Triacetin	lb.	.365 /	.405
Tributyl phosphate	lb.	.50 /	.535
Tributyrin	lb.	$0.69	
Tricresyl phosphate, comml.	lb.	.33 /	$0.36
Monsanto	lb.	.325 /	.36
Naugatuck	lb.	.33 /	.36
PX-917	lb.	.33 /	.36
Triphenyl phosphate, comml.	lb.	.39 /	.40
Monsanto	lb.	.415 /	.435
Turgum S	lb.	.1075/	.1175
SB	lb.	.07/	.08
Turpol NC 1200	lb.	.61 /	.70
Tysonite	lb.	.3025/	.305
United	gal.	.69 /	1.20
X-1 Resinous Oil	lb.	.0225/	.0325

Reclaiming Oils

Acintol C. P	lb.	.02 /	.03
Bardol, 639	lb.	.0275/	.0375
B	lb.	.055 /	.065
BRH 2	lb.	.0213/	.0351
BRT 3	lb.	.02 /	.031
4	lb.	.02 /	.031
7	lb.	.035 /	.036
BRV	lb.	.0625/	.065
Burco-RA	lb.	.053 /	.0805
BWH-1	lb.	.16 /	.18
Dipolymer Oil	gal.	.33 /	.43
Dispersing Oil No. 10	lb.	.06 /	.0625
G. B. Oils	gal.	.115 /	.275
Heavy Resin Oil	lb.	.0225/	.0375
LX-572	gal.	.27 /	.32
-759	gal.	.1375	
-777, -809, -859	gal.	.23 /	.33
-869	gal.	.33 /	.43
-871	gal.	.34 /	.44
No. 3186	gal.	.28 /	.295
Picco 6535	gal.	.25 /	.30
C-33	gal.	.215 /	.315
-42	gal.	.23 /	.33
D-4	gal.	.27 /	.37
E-5	gal.	.25 /	.35
Q-Oil	gal.	.286 /	.36
PT 101 Pine Tar Oil	lb.	.038 /	.0554
Reclaiming Oil #3186	gal.	.28 /	.385
-G	gal.	.25 /	.365
4039-M	gal.	.3275/	.3975
-V	gal.	.30 /	.37
RR-10	lb.	.37	
S. R. O.	lb.	.015 /	.0225
X-1 Resinous Oil	lb.	.0225/	.0325

Reinforcers, Other Than Carbon Black

Angelo Shellacs	lb.	.485 /	.7325
Borden, Chem. Div.			
Arcco 978-42B	lb.	.18 /	.19
1073-18B	lb.	.135 /	.145
1294-36B	lb.	.115 /	.125
1301-12B	lb.	.15 /	.16
BRC-20	lb.	.0235/	.0245
22	lb.	.026 /	.0285
30	lb.	.0165/	.025
521	lb.	.023	
Bunarex Resins	lb.	.065 /	.1225
Cab-o-sil	lb.	.67 /	.85
Calcene CO	ton	105.00 /	125.00
NC	ton	80.00 /	100.00
TM	ton	82.50 /	102.50
Calco S. A.	lb.	.85 /	.88
Car-Bel-Rez C	lb.	.126 /	.1451
Clays			
Aiken	ton	14.00	
Aluminum Flake	ton	22.25 /	60.00
Buca	ton	45.00	
Burgess Iceberg	ton	50.00 /	80.00
Icecap K	ton	65.00 /	90.00
Pigment #20	ton	35.00 /	60.00
#30	ton	37.00 /	60.00
Catalpo	ton	35.00	
Crown	ton	14.00 /	33.00
Dixie	ton	14.50	
Franklin	ton	13.50 /	35.25
L. G. B.	ton	17.50	
McNamee	ton	14.50	
Par	ton	15.00	
Paragon	ton	14.50 /	33.00
Pigment No. 33	ton	37.00	
Polyfil C	ton	25.00	
Recco	ton	14.00	
Suprex	ton	14.50 /	33.50
Swanee	ton	12.50	
Whitetex	ton	50.00	
Windsor	ton	14.00 /	30.00
Witco No. 1	ton	14.00 /	30.00
No. 2	ton	13.50 /	30.00
Clearcarb	lb.	.1175/	.1255
Cumar Resins	lb.	.065 /	.17
Darex Resins	lb.	.42 /	.49
DC Silica	lb.	1.15 /	1.40
Diatomaceous silica	ton	32.00 /	48.00
Good-rite 2007		.36 /	.38
2057		.30 /	.31
K Series Polymers	lb.	.15 /	.37
233	lb.	.08 /	.095
X303	lb.	.40 /	.45
Hi-Sil 233	lb.	.0825/	.0975
X303	lb.	.40 /	.45
Hycar 2001	lb.	.55	
2007	lb.	.39	
Indulins	lb.	.06 /	.08
Kralac A-EP	lb.	.43 /	.54
Laminar	ton	30.00	
Magnesium carbonate, Marinco CL	lb.	.11 /	.14
Marbon Resins	lb.	.36 /	.43
Multifex MM	ton	117.50 /	137.50
Super	ton	167.50 /	187.50
Neville Resins			
465	lb.	$0.073 /	$0.08
LX-509	lb.	.33 /	.35
Nebony	lb.	.045 /	.05
Paradene	lb.	.07 /	.08
R	lb.	.145 /	.205
Para Resins 2457	lb.	.04 /	.045
Parapol S-Polymers	lb.	.44	
Picco Resins	lb.	.1275/	.22
Piccolyte Resins	lb.	.205 /	.275
Piccoumaron Resins	lb.	.07 /	.19
Piccovars	lb.	.145 /	.20
Pliolite NR types	lb.	.98 /	1.33
S-3	lb.	.42 /	.49
S-6	lb.	.36 /	.43
-6B	lb.	.36 /	.43
E	lb.	.36 /	.43
Plio-Tuf G85C	lb.	.52 /	.59
Purecal M	ton	56.75 /	71.75
SC, T	ton	110.00 /	125.00
U	ton	120.00 /	135.00
R-B-H 510	lb.	.15 /	.22
Resinex	lb.	.0375/	.0525
Rubber Resin LM-4	lb.	.28 /	.35
Silene EF	lb.	.06 /	.07
L	lb.	.0575/	.0675
Silvacons	ton	55.00 /	85.00
Transphalt	lb.	.0375/	.0525
Witcarb P	ton	117.50 /	153.50
R	ton	127.50 /	163.50
Regular	ton	60.00 /	96.00
Zeolex 23	lb.	.055 /	.065
Zinc oxide, commercial	lb.	.135 /	.1775

Retarders

Benzoic acid TBAO-2	lb.	.44	
E-S-E-N	lb.	.37 /	.39
Good-rite Vultrol	lb.	.62 /	.66
R-17 Resin	lb.	.1075/	.36
Retarder ASA	lb.	.57	
J	lb.	.68 /	.73
PD	lb.	.39 /	.41
W	lb.	.46	
Retardex	lb.	.47 /	.50
Thionex	lb.	1.14	
Wiltrol P	lb.	.37 /	.39

Solvents

Bondogen	lb.	.555 /	.605
Butyrolactone	lb.	.60 /	.65
Cosol #1	gal.	.37 /	.43
#2	gal.	.42 /	.48
Dichloro Pentanes	lb.	.04 /	.07
Dipentene DD, Sunny South	gal.	.42 /	.63
Ethylene dichloride, comml.	lb.	.09 /	.122
Hi-Flash 2-50-W	gal.	.41	
Pale yellow	gal.	.39	
LX-572	gal.	.27 /	.32
-748	gal.	.16 /	.23
Methyl-2-pyrrolidone	lb.	.75 /	.80
Neville Nos. 100, 104	gal.	.52 /	.60
106	gal.	.38 /	.46
Nevsolv H, 200	gal.	.19 /	.29
HF, T, 30	gal.	.24 /	.34
Penetrell	gal.	.42 /	.63
Picco Hi-Solv Solvents	gal.	.16 /	.48
Pine Oil DD, Sunny South	lb.	.15	
Skellysolve-B	gal.	.17	
-H	gal.	.148	
-R, -V	gal.	.139	
-C	gal.	.762	
Stauffer Carbon Disulfide	lb.	.0525/	.085
Tetrachloride	lb.	.0825/	.475

Tackifiers

Acintol R	lb.	.065 /	.07
Bardol, 639	lb.	.0275/	.0375
Borden, Arcco			
A25, A26, 716-30	lb.	.18 /	.19
555-40R	lb.	.185 /	.205
620-32B	lb.	.20 /	.21
716-35	lb.	.17 /	.18
1041-21	lb.	.165 /	.175
BRH 2	lb.	.0213/	.0351
Bunarex Resins	lb.	.065 /	.1225
Chlorowax 70	lb.	.18 /	.24
Contogums	lb.	.0875/	.11
Cumar Resins	lb.	.065 /	.17
Galex W-100	lb.	.155 /	.17
W-100D	lb.	.1525/	.1625
Indopol H-35	gal.	.65 /	.84
H-50	gal.	.70 /	.89
-100	gal.	.85 /	1.08
-300	gal.	1.00 /	1.24
-1500	gal.	1.48	
L-10	gal.	.40 /	.59
-50	gal.	.45 /	.64
-100	gal.	.55 /	.74
Kenflex resins	lb.	.18 /	.27
Koresin	lb.	.90 /	1.10
Natac	lb.	.12 /	.13
Nevindene	lb.	.15 /	.18
Picco Resins	lb.	.1275/	.22
Piccolastic Resins	lb.	.1855/	.34
Piccolyte Resins	lb.	.185 /	.25
Piccopale Resins	lb.	.089 /	.13
Piccoumaron Resins	lb.	.07 /	.185
R-B-H 510	lb.	.15 /	.22
Roelflex 1118A	lb.	.39	
Synthetic 100	lb.	.41	
Synthol	lb.	.17 /	.2625
United	gal.	.69 /	1.20

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Note

Suppliers are requested to submit product additions or deletions and price changes promptly as they occur in order that we may make the listing of maximum service to our readers. Comments on the present listing and classifications are invited with a view toward facilitating location of specific items.

Correspondence should be directed to: Market Editor, RUBBER WORLD, 630 Third Avenue, New York 17, New York.

Vulcanizing Agents

Dibenzo G-M-F	lb.	$2.60
G-M-F #113, #117	lb.	.90
Di-Cup	lb.	1.10
Dodecenyl succinic anhydride	lb.	.75 / $0.76
HMDA-Carbamate	lb.	4.50 / 4.90
Ko-Blend I. S.	lb.	.39
Litharge (*See Accelerator-Activators, Inorganic*)		
Magnesium oxide	lb.	$0.2525/ $0.38
Maglite D, K, Y	lb.	.2525/ .305
L	lb.	.2975/ .3225
M	lb.	.27 / .32
Marmag	lb.	.2475/ .295
PSD 85	lb.	.37 / .50
Red Lead (*See Accelerator-Activators, Inorganic*)		
Sulfasan R	lb.	1.55 / 1.57
Sulfur flour, commil. 100	lbs.	2.55 / 3.30
1018	lb.	.12 / .1575
Aero	100 lbs.	2.40 / 7.75
Crystex	lb.	.195 / .23
Insoluble 60	lb.	.125 / .13
Rubbermakers	100 lbs.	2.65 / 4.55
Stauffer	lb.	.0265/ .054
Telloy	lb.	2.75
VA-7	lb.	.50 / .60
Vandex	lb.	7.50
Vultac No. 2	lb.	.47 / .74
3	lb.	.51 / .78
White lead silicate (*See Accelerator-Activators, Inorganic*)		

Industrial Fabrics

(*Continued from page 306*)

From mills, however, rather than from second-hands, buyers in need of extra-wide and heavy grey cottons are getting some of the weaves, weights, and widths they require, it is reported. To some extent the slow-up among coaters restrains what otherwise would have had an accentuated influence of prevailing shortages.

Industrial Fabrics

Broken Twills*

54-inch, 1.14, 76x52	yd.	$0.52
58-inch, 1.06, 76x52		.585
60-inch, 1.02, 76x52		.5825

Drills*

59-inch, 1.85, 68x40	yd.	.365
2.25, 68x40		.2975

Osnaburgs*

40-inch, 2.11, 35x25	yd.	.2275
3.65, 35x25		.1525
59-inch, 2.35, 32x26		.275
62-inch, 2.23, 32x26		.2875

Ducks

Numbered Duck†

List less 45%

Enameling Ducks*

	S. F	D. F.
38-inch, 1.78 yd.	$0.3263	.3313
2.00 yd.	.275	.28
51.5-inch, 1.35 yd.	.45	.46
57-inch, 1.22 yd.	.4838	.50
61.5-inch, 1.09 yd.	.5413	.5538

Hose and Belting Duck*

Basis	lb.	$0.60

Army Duck†

52-inch, 11.70 oz., 54x40 (8.10 oz./sq.yd.)	yd.	.5925

Sheeting*

40-inch, 3.15, 64x64	yd.	.2175
3.60, 56x56		.185
52-inch, 3.85, 48x48		.2275
57-inch, 3.47, 48x48		.235
60-inch, 2.10, 64x64		.36
2.40, 56x56		.31

Sateens*

53-inch, 1.12, 96x60	yd.	.565
1.32, 96x64		.52
57-inch, 1.04, 96x60		.615
58-inch, 1.02, 96x60		.625
1.21, 96x64		.5725

Chafer Fabrics*

14.40-oz./sq.yd. P.Y.	lb.	.67
11.65-oz./sq.yd. S.Y.		.61
10.80-oz./sq.yd. S.Y.		.61
8.9-oz./sq.yd. S.Y.		.67
40-inch, 2.56, 35x25		.25
60-inch, 1.71, 35x25		.435

*Net 10 days.
†2% 10 days.

Aid For Smallholder

(*Continued from page 302*)

350,000 smallholders, many of whom produce dirty sheet, much of it sold wet as No. 4 or 5 unsmoked sheets. The Advisory Service started an experimental group-processing center and smokehouse in one village community, demonstrating R.R.I. standard techniques. Growers in another kampong were sufficiently impressed by the results to set up similar facilities of their own (with the aid of the Advisory Service), the first, it is emphasized, to be built and equipped entirely by those who will use them. Each smallholder processes his own rubber individually according to improved methods; the rubber is smoked in the communal smoke house for a fixed charge. Grade one and two smoked sheet are thus produced. Now a mobile demonstration unit of the Advisory Service is touring the kampong rubber areas to spread this method of group-processing.

Pelletized News

INTERNATIONAL FINANCE CORPORATION (IFC) will invest $225,000 in Rubbertex (Australia) Pty., Ltd., Melbourne, for expansion of manufacturing operations, Robert L. Garner, president of IFC, recently announced. Rubbertex is owned entirely by Australian interests; George L. Flack is its managing director. The company, started in 1946, makes aircraft, industrial, automotive, and medical goods of natural and synthetic rubber, as well as rubber to metal bonded articles for vibration damping. It has licensing agreements with Connecticut Hard Rubber Co., New Haven, Conn., U.S.A., and now also with Lord Mfg. Co., Erie, Pa., U.S.A., which, combined with expanded production facilities, will enable it to manufacture certain products in Australia which have hitherto been imported.

IMPERIAL CHEMICAL INDUSTRIES and SHELL CHEMICAL CO. in the United Kingdom have made license agreements with Montecatini, Milan, Italy, for the industrial exploitation of the Montecatini and Montecatini-Ziegler patents covering the production of polypropylene for plastic uses. These are already manufactured and sold in Italy under the trademark, Moplen. Both licensees will begin plant construction immediately. These new license arrangements are a further authoritative international acknowledgment of original Montecatini inventions and important results of its research.

INSTITUT FRANCAIS DU CAOUTCHOUC arranged a symposium on tire behavior in Paris, France, May 20, 21, and 22. Papers covered behavior of tires under different service and road conditions, but not tire manufacture, rubber formulations, and the like. The official languages were English, French, Russian, Chinese, and German.

Moplen (polypropylene) is reportedly to be produced in France by two French concerns, Pechiney and Société Normande de Matieres Plastiques, under license from Montecatini. Initial output is expected to total 10,000 tons a year.

Synthetic Rubbers

(*Continued from page 308*)

OB-102		$0.1825[a]
-104		.1475[a]
-106		.151[a]
-110		.141[a]
-111		.154[a]
-113		.175[a]
Philprene 1803		.174[b]
S-1803		.165[a]
-1804		.175[a]
Synpol 8250	.174[b] /	.18[b]
8253	.1584[b]/	.1644[b]
8254	.1545[b]/	.1605[b]
8266	.1598[b]/	.1658[b]

Cold SBR Rosin Masterbatch

Copo 3900	$0.231[c] /	.237[c]

Cold SBR Latex

CL-101		.28[a]
Copo 2101	.30[c] /	.4025[c]
2102, 2105, 2110, 3851	.32[c] /	.3725[c]
2108	.30[c] /	.3675[c]
2109	.2775[c]/	.3450[c]
3852	.2900[c]/	.3500[c]
FR-S 2105	.32[c] /	.366[c]
Naugatex 2105, 2107	.32[a] /	.38[a]
2108	.30[a] /	.38[a]
2113	.29[a] /	.36[a]
Polysar Latex 721		.32[c]
Pliolite Latex 2101		.30[c]
2105, 2107		.32[c]
2108		.30[c]
S-2101		.26/
-2105		.28[a]
-2107		.32[a]
2108		.29[a]

Cold BR Latex‡

Pliolite Latex 2104		.325[a]

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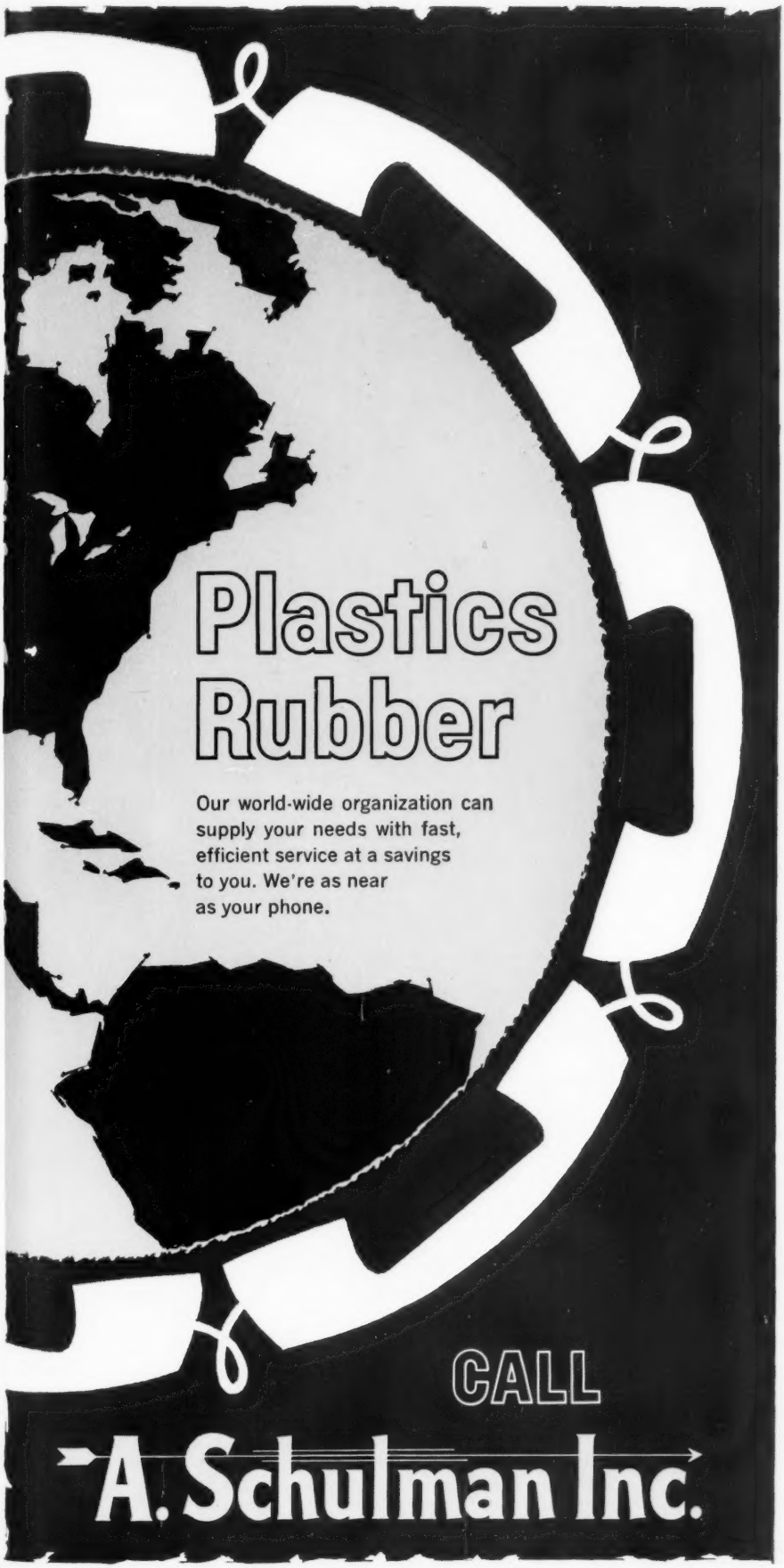
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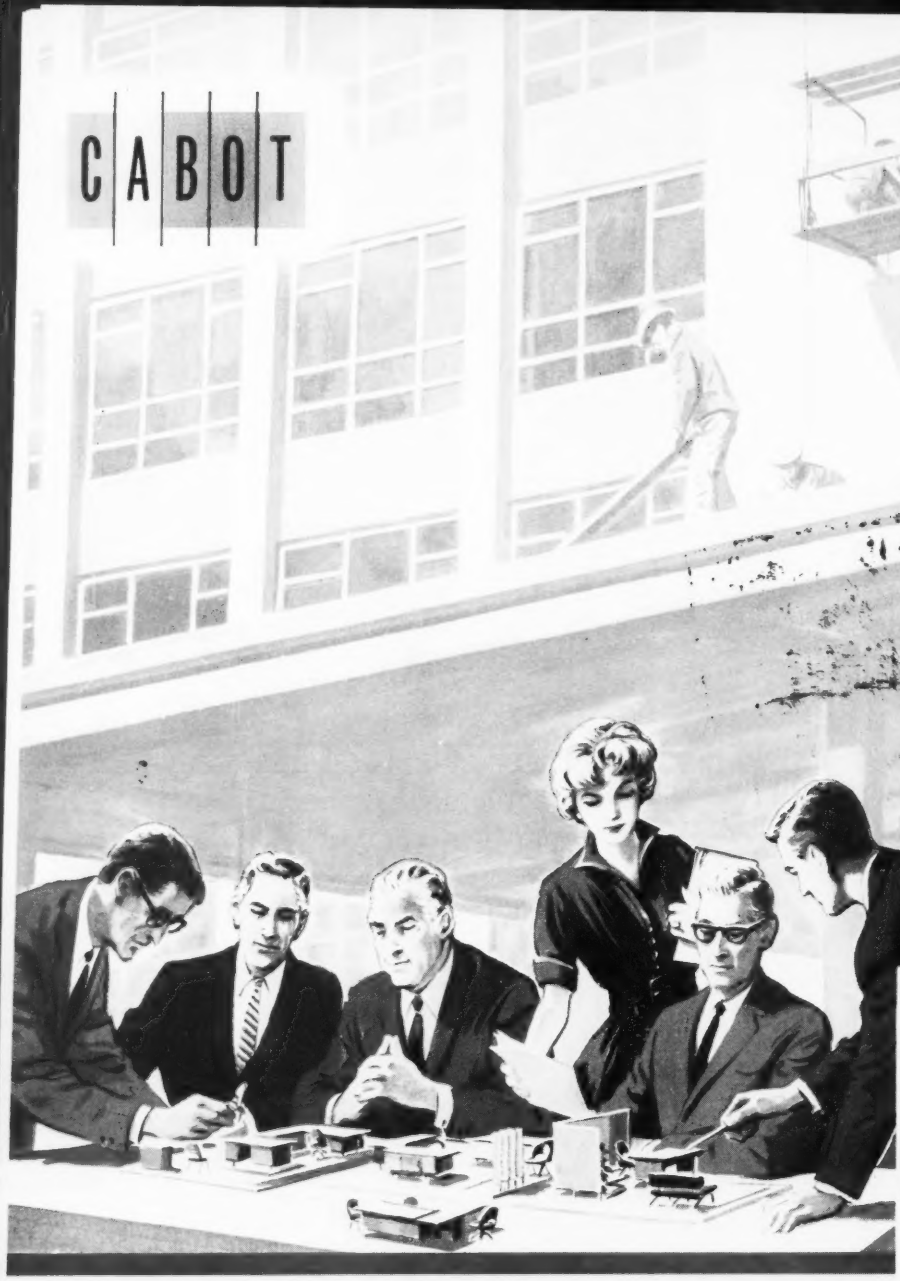

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